

MODERN PLASTICS

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MARCH 1939

VOLUME 16 NUMBER 7

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Cover color this month SIERRA GREEN (Created by Textile Color Card Association)	



A P R I L

With automotive manufacturers rapidly becoming Plastics' Number One customer, we have chosen next month as an appropriate time to show just how plastics are being used in the cars of 1939. William T. Cruse of the Celluloid Corporation has written the story, almost everyone has contributed photographs, and Chrysler Corporation has furnished four panels which illustrate the 104 parts used in its line this year

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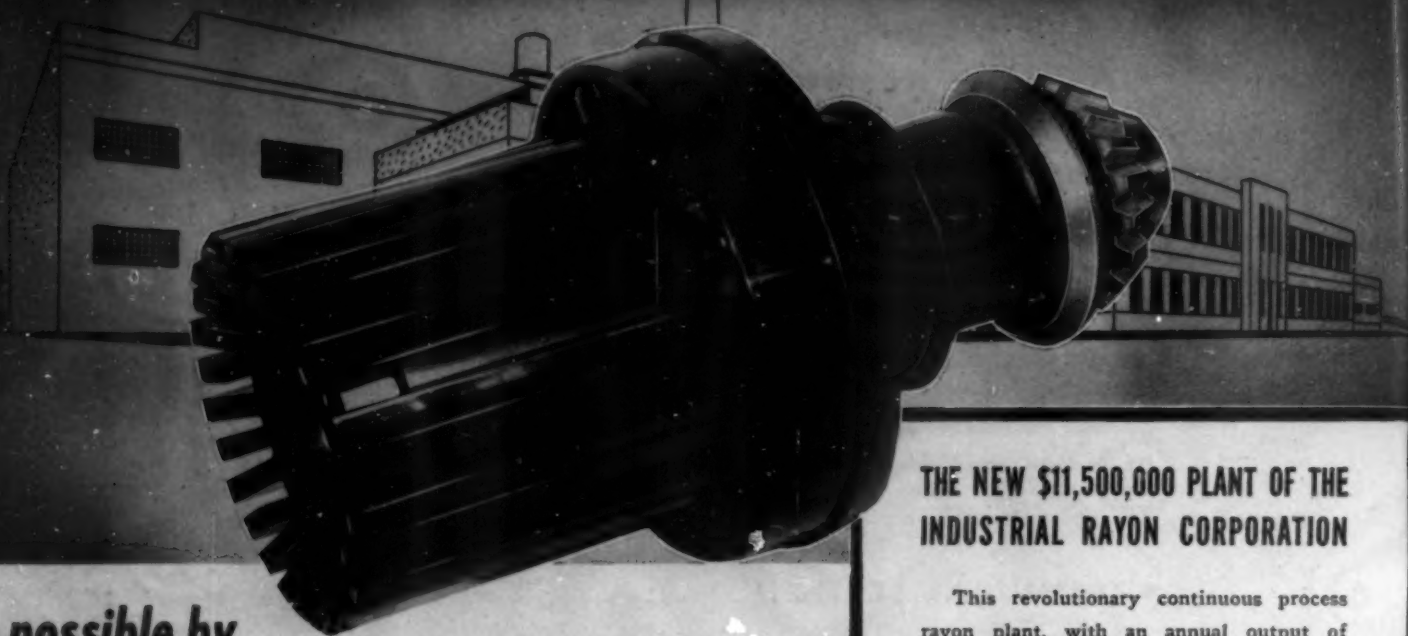
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MARCH 1939

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FIRST AND ONLY CONTINUOUS VISCOSE RAYON PLANT



made possible by
the PLASTIC SPINNING REEL
Precision Molded by Richardson

In Painesville, Ohio, stands the world's first plant for the continuous production of viscose rayon yarns. There a succession of chemically resistant plastic reels of ingenious, highly-developed design, make it possible to carry rayon yarn from the spin bath where it is formed, through all the processing, cleansing, drying and twisting operations to plastic bobbins on which it is first wound up.

Costly, time-consuming operations and multiple handling are eliminated by use of the reels, which carry each individual thread through all the processing stages for direct treatment, in-

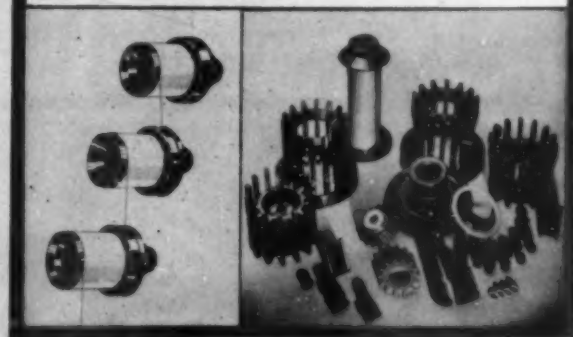
suring the ultimate in product uniformity.

Heart of the continuous process is the plastic spinning reel, developed with Richardson collaboration from complex experimental models to a simple precision molded composite reel. In addition, numerous other Richardson molded and laminated plastics are widely used—jet unions; thread guide holders and brackets; INSUROK laminated gears and seal rings; bobbins and other parts—because of their unvarying physical characteristics and resistance to all spinning and processing liquors.

THE NEW \$11,500,000 PLANT OF THE INDUSTRIAL RAYON CORPORATION

This revolutionary continuous process rayon plant, with an annual output of 12,000,000 pounds, is the result of many years of experimental and developmental work. Perfected by Rayon Machinery Corporation, wholly owned subsidiary of Industrial Rayon Corporation, this process was made possible by the molded plastic members of the reel.

Richardson engineers, designers and plastics technicians are proud to have had an active part in writing this new epoch-making chapter in the history of the rayon industry.



Devoted exclusively to plastics, Richardson has unexcelled facilities for the volume production of intricate molded and laminated parts and finished products to exact specifications. Richardson complete service, and the same engineering and technical skill that proved its value in the Industrial Rayon Corporation development, are available to all users of plastics.

INSUROK

the superior plastic by Richardson, is available in sheets, rods, tubes, punchings, and other forms for fabrication in your plant, or in completely finished parts ready for assembly. Richardson facilities encompass the use of Bakelite, Beetle, Durez, Indur, Plaskon, Resinon, Tenite and other forms of synthetic resin plastics. Literature and INSUROK catalogues on request.

The RICHARDSON COMPANY

Melrose Park, Chicago 11, Ill.

New Brunswick, N. J.

Minneapolis, 2nd

Lockport, Ill.

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Hundreds of banks of these plastic reels are required to produce the twelve million pounds of rayon yarn turned out annually by Industrial Rayon Corporation

PITY THE SHEEP

Rayon, America's most popular textile, catches up with wool

"THE PROCESS ITSELF, MADE POSSIBLE BY AN ingenious, highly developed reel composed of chemically resistant molded plastic members, is the result of years of experimental and developmental effort."

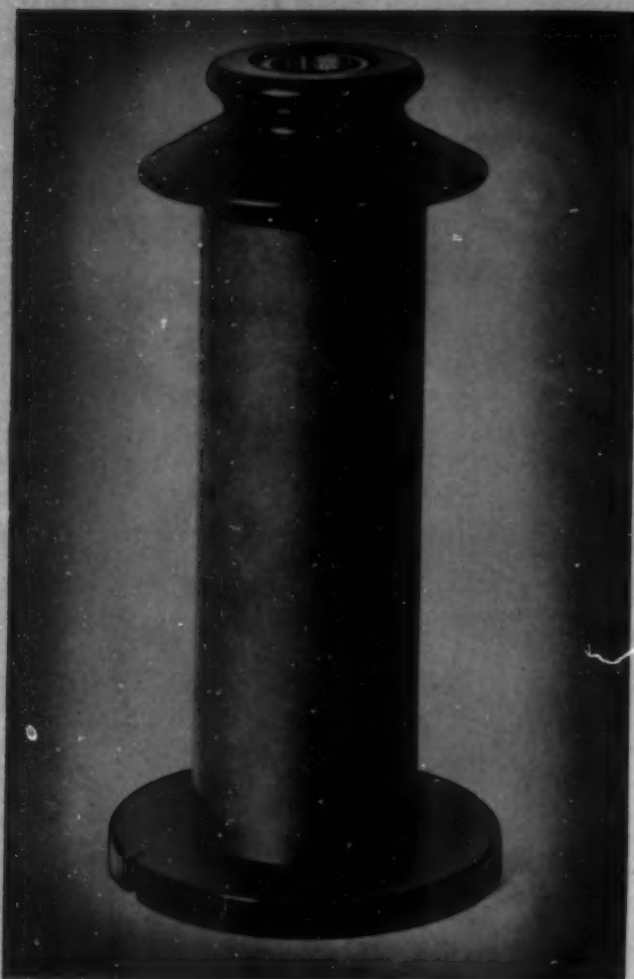
Thus R. F. Bergmann, Chief Engineer of the Rayon Machinery Corporation, Cleveland, Ohio (wholly owned subsidiary of Industrial Rayon Corporation) in describing the new, continuous process for the spinning of viscose rayon yarn developed by his company, pays tribute to modern synthetic plastics and their increasing use in commerce, science, the arts and industry.

While rayon has been successfully manufactured in the United States less than thirty years, yet its acceptance as a basic fabric finds it America's most popular textile, with six times as much rayon as silk being used. It has

practically caught up with wool, and 1938 saw a full tenth as much rayon used as cotton. 312,236,000 pounds of rayon yarn were produced in the United States in 1937 . . . about 75 percent of this total by the viscose process. It remains the lowest cost process yielding satisfactory yarn, mainly because of the lower cost of basic raw materials and chemicals used in treating the yarn.

To get the full import of Mr. Bergmann's statement, it may be well briefly to review the development of rayon, itself a synthetic material.

Rayon, first used as a textile term in the United States in 1924, is the name by which some of the synthetic fibers, frequently called artificial silk, are commonly known. Its technical definition (U. S. Dept. of Commerce) is as follows: Rayon is the generic name of fila-



ments made from various solutions of modified cellulose by pressing or drawing the cellulose solution through an orifice and solidifying it in the form of a filament or filaments, by means of some precipitating medium.

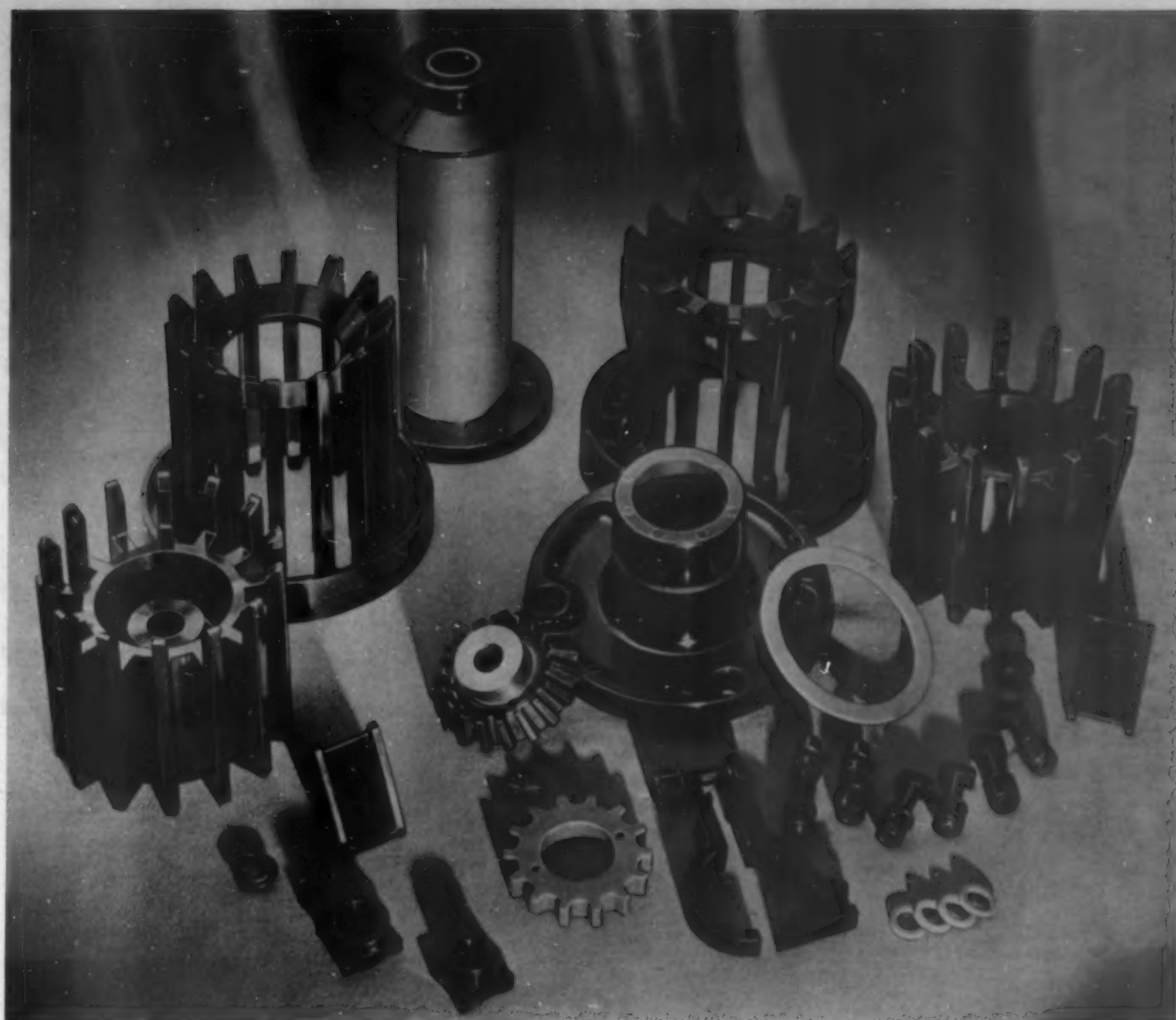
As far back as 1664 the idea of copying the work of the silkworm was suggested by Robert Hooke and in 1734 by R. A. F. DeReaumur. However, the age of artificial silk really began with Comte Hilaire de Chardonnet, who was a student under Pasteur at a time when his investigations into silkworm disease culminated, and this, undoubtedly, was the inspiration that started Chardonnet on his life work. After 30 years of effort he took out his first patent for collodion, nitro- or Chardonnet silk in 1884-85. J. W. Swan on December 4, 1884, produced a fabric which he described as "artificial silk"—the first recorded use of that designation. However, great technical difficulties were encountered in adapting these early methods to factory operation and the costs of production were higher than the cost of real silk.

The development of artificial silk on an extensive scale began with the discovery of viscose by Cross and Bevan in 1892, and the invention of the Topham spinning box in 1900. By 1910 viscose silk amounted to 20 percent of the world's artificial silk output; by 1927 it had grown to 84 percent of a total output of some 280 million pounds. For this quantity 130,000 tons of wood pulp (2 percent of the world's total pulp output) were required. As previously mentioned, the 1938 rayon production had risen in excess of 312 million pounds, approximately 75 percent of which was produced by the viscose process.

Today two widely used methods of producing viscose rayon yarn are employed. In the conventional "pot-spinning" (centrifugal) machine viscose is forced under pressure through jets submerged in an acid bath. Each jet has from 40 to 90 microscopic holes through which the viscose is extruded, each hole producing a distinct stream of viscose which immediately coagulates upon contact with the acid, forming a tiny filament of yarn. The coagulated yarn is drawn away from the jet and fed into the inside of an acid-resisting plastic spinning pot that rotates at a speed of 8000 to 10,000 r.p.m. The centrifugal force exerted by the yarn against the walls of the revolving pot causes the yarn to build up in the form of an annular ring, known in the industry as a "cake." The rate of feed of the yarn into the pot, in conjunction with the high rotating speed of the pot, causes a twist of $2\frac{1}{2}$ to 3 turns to the inch to be put into the yarn.

In spool spinning the viscose filaments are carried through thread guides mounted on a transverse mecha-

The precision molded and balanced bobbin (top left) revolves at eight thousand to ten thousand r.p.m. Its top and base are molded Insurok while the cylinder is laminated Insurok. The spinning reel, molded of Durez by the Richardson Co. (center left) is the handling medium of the continuous viscose rayon yarn production process. A cut-away section (lower left) shows the construction of the reel



Molded and laminated jet unions, thread guide holders, brackets, seal rings, washers, gears and other plastic parts are important adjuncts to the smooth functioning of the rayon yarn process. (All photos, courtesy Industrial Rayon Corp.)

nism, and are laid evenly on a revolving spool, controlled by a differential speed device to compensate for the increased package diameter as the yarn builds up on the spool, so as to produce finished yarn of predetermined uniform weight per unit of length.

The spool upon which the yarn is wound is usually made of perforated aluminum, coated with an acid-resisting plastic paint.

Both these methods have definite limitations. If the freshly spun yarn is permitted to dry when restricted in cakes or on spools, it will develop inequalities in its properties, depending upon strains to which the yarn is subjected. Further, yarn in any such bundle or package is subject to varying intensity of treatment, both chemical and physical, depending upon which part of the yarn is more exposed. Such irregularities are minimized by reeling the wet yarn into skeins which, through a series

of costly time-consuming successive operations, are processed and dried in a loose and free condition, eventually to be wound as a cone of finished, bleached and twisted yarn ready for the market.

In the spool system, unlike the centrifugal process, twisting does not take place coincidental with spinning. Therefore, some form of equipment for twisting as a separate operation is necessary.

But now the new process combines into one continuous series of operations all steps from spinning to drying and twisting the yarn on bobbins, accomplished by building into one complete machine a spinning unit equipped with continuous molded plastic reels, a "stepped" inclined processing panel also equipped with continuous plastic reels on which the yarn is chemically treated, washed and dried as it travels from one reel to another down a vertical run; finally to the (Please turn to page 60)

VISUALIZING POWER HOOKUPS

by PHILIP W. SWAIN*

SOME OF US MECHANICAL ENGINEERS MAY BE forced to study art if the makers of plastics keep on tempting us with their colorful and form-suggesting materials, so unlike the cast iron and steel of our hard-boiled apprenticeship. From 1882 to the latter half of 1937, more than half a century, the editors of *Power* kept plugging away at their editorial task, with never a suspicion that plastics would some day become a working tool of engineering journalism. Their job was to explain the practical uses of boilers, turbines and engines; plastics were for cosmetic containers, bottle caps and radio cabinets—or so they thought.

In 1938 we said goodbye to all that. From February until November we spent 300 man hours carving machine models out of rods and sheets of cast resin, and another 1500 hours assembling these units into seventy miniature "power plants." The final result of these pioneer labors was our issue of December 1938—the forty-eight page *Handbook of Hookups*, devoted exclusively to the model photographs, with concise explanatory captions.

* Editor of *Power*.

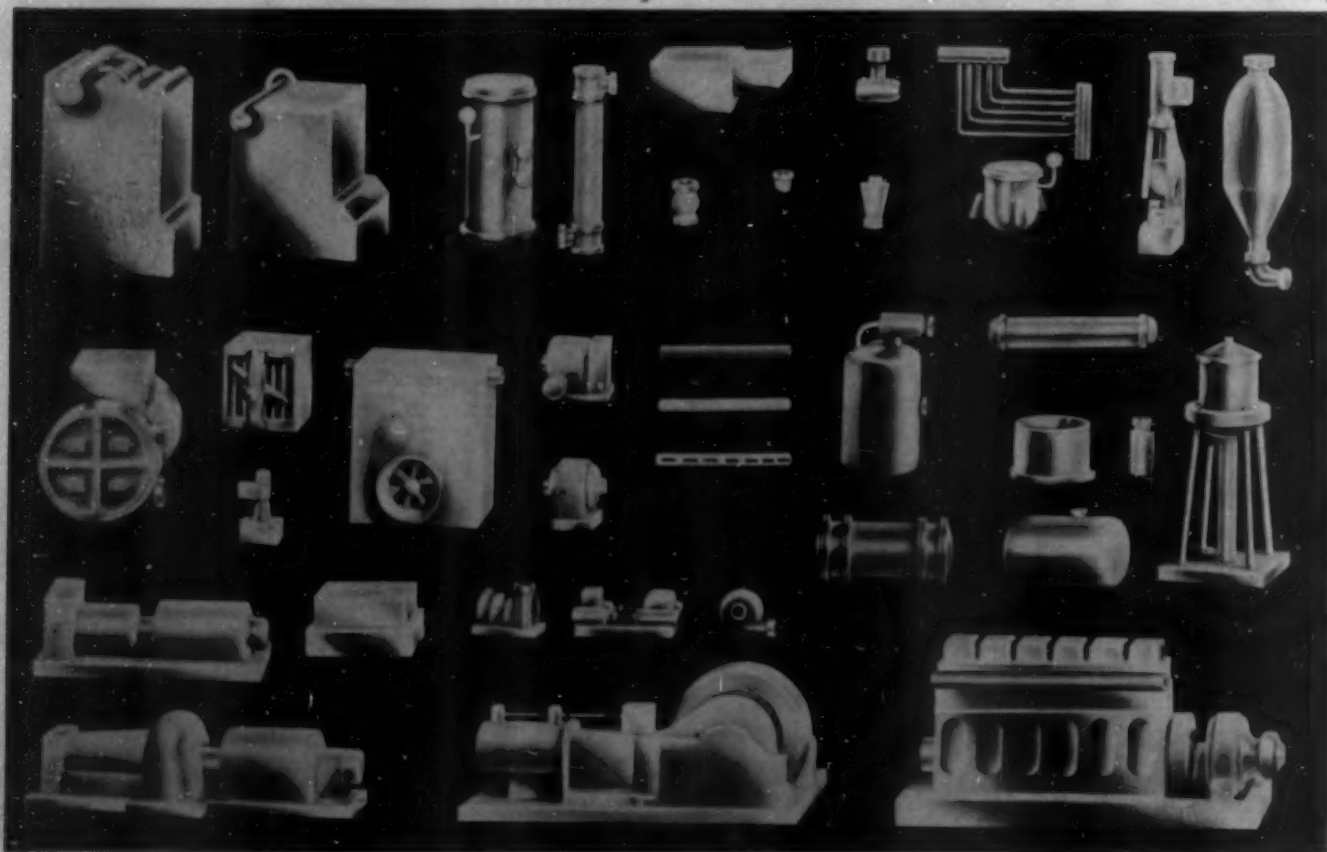
From time immemorial, engineers and engineering editors have used models occasionally. We believe, however, that never before have the editors of a technical magazine discarded pen and typewriter to carve a complete three-dimensional issue out of the solid.

The samples pictured give an idea of the standardized technique employed throughout the Handbook. Ivory-like natural cast phenolic was selected for the equipment models after months of experimentation with wood, wax, soap and metal. Steam and water piping was simulated by rods of duralumin and steel ($\frac{3}{16}$ and $\frac{1}{8}$ in.) neatly formed in specially constructed bending fixtures. After each hookup assembly was completed and photographed, it was dismantled so that the unit models could be used again in the next hookup.

Fabrication of the seventy hookups required more than 100 different plastic models, ranging from a motor $\frac{3}{4}$ in. wide to an elaborate steam engine 5 in. long. The boiler shown in the upper left corner of Fig. 1 is 2 in. wide.

Through duplication in various hookups these models appeared a total of 780 times. If we multiply this figure

Here are thirty-seven of the key models shaped from Catalin by the author to visualize power hookups. They range from boilers (upper left) through economizers, reducing valves, exhaust heads, surface condensers, radiators, cooling towers, tanks, turbines to steam and Diesel engines at the lower right



by the 28,000 copies printed we find we have distributed, in the United States and abroad, 21,840,000 separate pictures of individual plastic models, for which astronomical result you may blame Gutenberg and the chemists.

It should be noted that the carving was the easy end of the job and that the cost of plastics was but a small fraction of one percent of the total cost of the finished hookups. Twenty pounds of resin versus 1800 hours of model making and photographing! If we add time spent planning, writing, editing and printer chasing, the total editorial time to produce this book amounts to 2500 hours, about 50 hours per page.

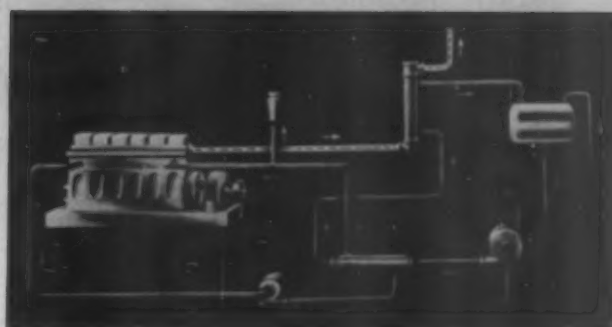
Forming the piping was a really stupendous task. For one thing, we had to make 1493 true bends in the dural and steel rods and a total of 209 soldered outlet joints. Where soldered outlets were necessary we used steel rod—elsewhere duralumin to keep the assemblies from sagging of their own weight.

Before photographing each hookup, we painted its steam piping flat white and its water piping flat gray. Flow arrows were added in the photo retouching. Reproduction was by the Aquatone printing process on special high-quality rough-surface white paper.

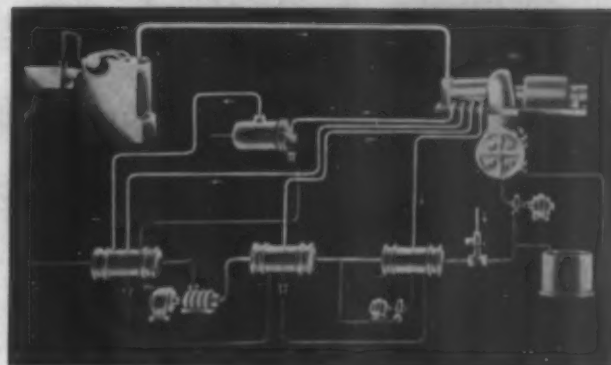
When it came to the photography we faced problems of extreme technical difficulty. In the matter of lighting, for example, the requirements of art and of engineering were directly opposed. The engineering use of the photos as diagrams required uniform grays and whites in the piping, which, in turn, called for flat lighting. "Art" called for contrast lighting of the machine models. We compromised with a mixture of the two types of lighting, and then made up any shortcomings by retouching.

If we had this job to do over again we would be inclined to light exclusively to beautify the models and then restore the piping by retouching. We might also experiment with a darker and more opaque plastic; the delicate opalescence of the "natural" cast resin, so pleasing to the eye, tends to get lost in the process of photographing and printing, unless extensive retouching is used. On the other hand, plastics of this tone and translucence are ideally suited to the requirements of exhibition models.

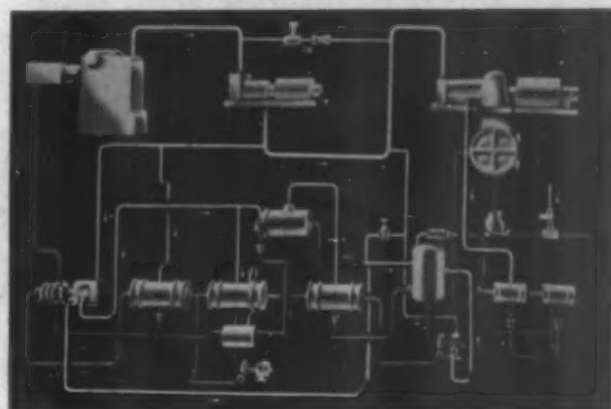
In addition, we faced, and completely solved, a problem in photographic geometry. You will note from the samples—and this holds throughout the book—that our photos are "square" front views (vertical pipes appear as vertical lines and left-right pipes (Please turn to page 60)



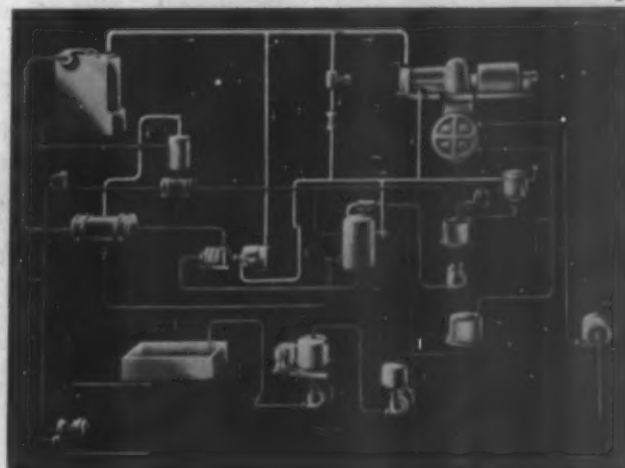
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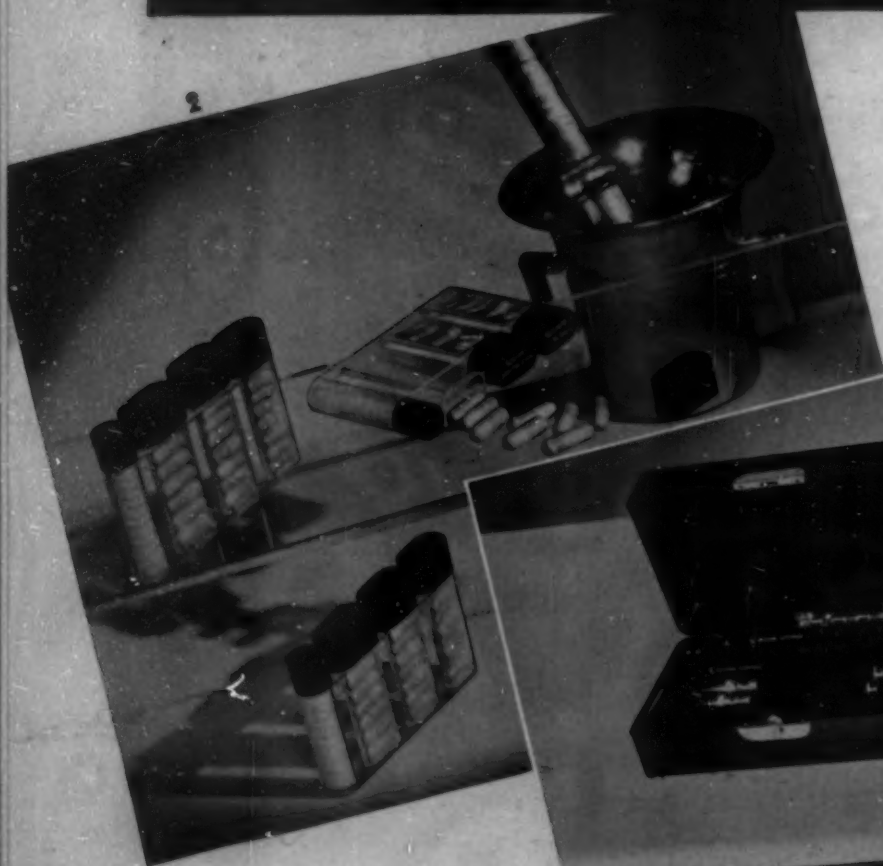
Fig. 2—Usual Diesel converts about 1/3 of fuel heat into useful output. This hookup shows how this can be increased to more than 1/2 by recovery of heat in exhaust gas as well as in jacket water. Fig. 3—A central station layout. Fig. 4—Another central station showing high-pressure top, and tie-in with existing heat balance. Fig. 5—An industrial hookup requiring heavy power load, and process demand for large quantities of hot water in a textile plant

1



RENOVED IN ALL-AMERICA

2



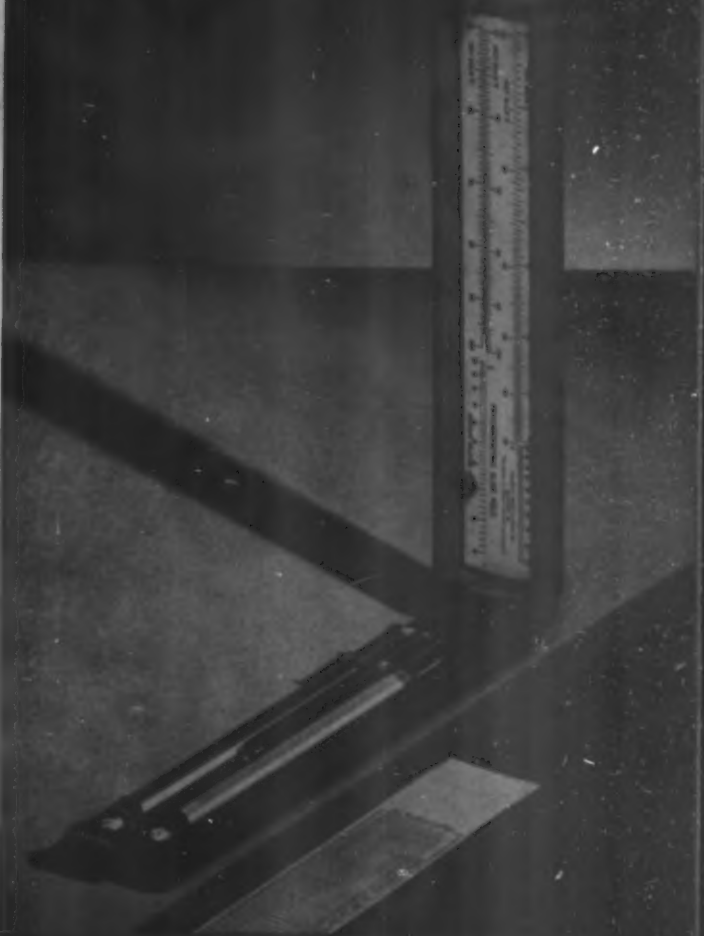
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Winners of awards in the Plastics Container Group of the 1938 All-America Package Competition, sponsored by *Modern Packaging* magazine are: (1) St. Clair Mfg. Co.'s "Razorette" in its "tear drop" shaped container made in harmonious color combinations. Designed by Leighton Dunning, in charge of the Packaging Design Dept. of the company, in collaboration with the molders, the Chicago Molded Products Corp., the case is made of Lumarith. (2) Transparent case with four wells, used by Eli Lilly & Co. for assorted capsules and tablets. The entire case is molded by Kurz-Kasch, Inc., who used Lucite for the wells and black Bakelite for the caps. (3) Mahogany colored Bakelite case for Wrico Lettering Sets. This compact, efficient case, designed by Earl Mandle for Wood-Regan Instrument Co., is molded in two parts—lid and bottom—by Auburn Button Works, Inc. The Wrico name is molded into the case, both outside and inside.

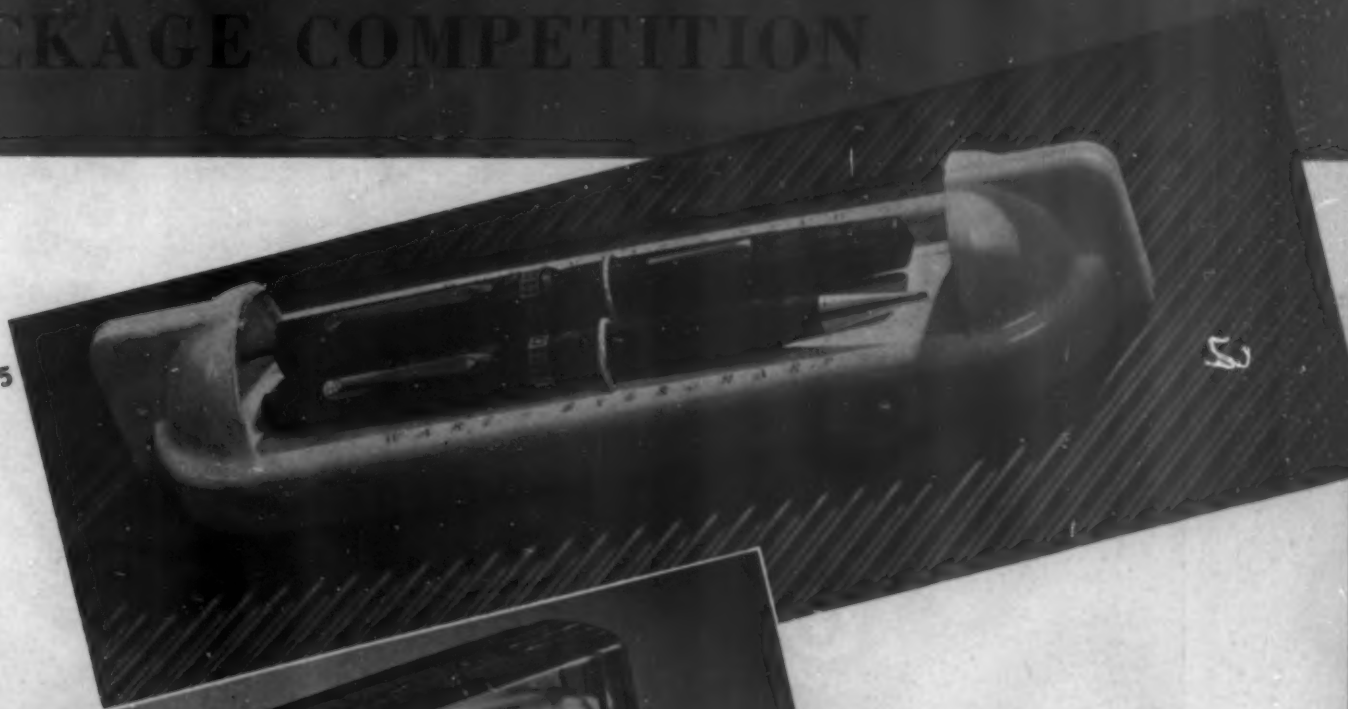
Plastic Container entries receiving Honorable Mention are: (4) Psychrometer case designed and marketed by Julien P. Friez & Sons, Inc. This container, molded of Arcolite by Consolidated Molded Products Corp. is said to improve the accuracy and sensitivity of the instrument by reducing errors from radiated or conducted heat to or from the thermometer. (5) Wahl Eversharp Pen & Pencil case designed by Kenneth Olson for the Wahl Co. It is molded of Bakelite in a choice of white and two colors, by Auburn Button Works, Inc. The pen and pencil can be inspected through an inserted transparent cellulose "bay window" which protects the set from dust and dirt. (6) Electric Shaver case with transparent Lucite top and Bakelite base molded by General Industries for Berg-Johnson, Inc. The coiled cord slips into the lower half of the case while the shaver fits into the top section.

4



PACKAGE COMPETITION

5



6





LAMINATED INDUSTRIAL BEARINGS

by HARLAN F. HORNE*

If longer bearing life, lower power consumption, elimination of oil or grease cost, interest you—read what this engineer has to say about phenolic laminates

INHERENT ADVANTAGES OF LAMINATED PLASTIC bearings are constantly extending their use into new fields, replacing metallic bearings in many applications. The advantages of the substitution of a laminated bearing under these conditions may include: (1) longer bearing life, (2) lower power consumption, (3) elimination of oil or grease cost, (4) prevention of contamination, etc. In the past when oil or grease lubrication was difficult or sometimes impossible, engineers have been forced to employ a material such as Lignum Vitae which may be operated fairly satisfactorily with water or other low viscosity liquids. This material, however, being a natural product is subject to considerable variation in quality and does not possess sufficient wear resistance nor compressive strength for many applications where a material of this type is desirable. It is also difficult to cut bearings from a Lignum Vitae log economically.

Laminated plastic bearings have all the advantages of wood bearings with many improved characteristics. Thus the compressive strength of some phenolic laminates is 35,000 pounds per square inch as compared to Lignum Vitae's 10,000. This quality can be accurately controlled. It is also practical to incorporate supplementary materials which have a marked effect on the hardness, wear resistance and lubrication characteristics of the resulting product. Because of the variety of forms in which phenolic laminated material is manufactured, it lends itself to numerous bearing shapes with a minimum of machining and waste.

Some of the markedly successful applications of such bearings, replacing either metal or wood, are briefly described in this article. Complete coverage is not possible in any one article but the variety of uses is remarkable, especially considering the fact that the laminated plastic bearing is only about ten years old.

*Micarta Engineer, Westinghouse Electric and Manufacturing Company.

Fig. 1—Illustrates the use of a Micarta bearing on the tube mill in a cement plant where as you can imagine it is subjected to plenty of abrasion.

Fig. 2—Shows a 44 in. diameter bearing for Marcy ball mill. Fig. 3—

One of the presses and molds in the Westinghouse plant where large segmental bearings are shaped from phenolic impregnated materials for heavy industry. The material is not only shaped in the mold under pressure but it remains under pressure during the full curing cycle. When removed from the press, little finishing is required

Deep well pump bearings

The problem of oil lubricating deep well pump bearings has always been a difficult one and required piping running the entire length of the vertical shaft to supply oil and keep water out. This shaft is frequently as long as 400 feet, so that installation costs were high and there was little assurance that oil introduced at the top would properly lubricate the lower bearings. The ideal requirement for this job was a bearing which could be lubricated by the water pumped without being cut out by the sand usually present. It must also be capable of being operated dry for the few seconds elapsing from the time the pump is started until the water height reaches the bearing.

Laminated material has been tested and used for over two years by two pump manufacturers with no appreciable wear and with results far superior to either metal or composition bearings of other types. This was practically noted in the improved (*Please turn to page 62*)





Modeled by Sally Southgate Alling and cast of Prystal in a rubber mold by her husband Dr. Eric L. Alling. Mrs. Alling creates *object d'art* for retail distribution in the better shops and Dr. Alling, a practicing physician, has taken up their production in plastics as a hobby. He has worked out a method of curing cast resins in a few hours without the aid of a chemical accelerator

PREVULCANIZED LATEX MOLDS

by GEORGE D. KRATZ*

A method of casting resins in which popular interest is mounting rapidly

PROBABLY NO INNOVATION IN THE MOLDING field found quicker acceptance than the casting of prevulcanized latex solutions in plaster. By the simple substitution of the proper type of liquid latex for plaster of Paris, the same objects could be produced more accurately by the same operation. The cost was but a trifle higher and resulted in a product which is not only practically unbreakable but, if desired, is flexible. Now, by reversing the process, it is possible to cast certain plastics in prevulcanized rubber molds. The advantages of a flexible rubber mold into which a plastic may be poured either hot or cold, allowed to condense and then removed from undercuts are so obvious that a further explanation is unnecessary.

This development is relatively recent and like most new processes started modestly. One of its first applications was for the reproduction of novelty jewelry. Particularly enough, it was the small manufacturer of such products rather than his supplier of plastic materials who first realized that by using rubber molds he could overcome many of his major difficulties.

In the short space of two or three years, this application in connection with casting plastics has been extended from jewelry to statues eight or nine feet in height. There are certain definite reasons for this, not the least being ease in handling, little or no technical control, better definition and the opportunity to make numerous duplicate casts from the same mold.

This is written essentially with regard to the preparation of the molds, of which several types are already in wide use, and very little will be said in regard to the type of plastic to be employed for casting. It should be borne in mind, however, that whatever plastic is selected, if poured hot and allowed to cool the temperature should not ordinarily exceed 200 deg. F. if the life of the mold is a consideration. The same temperature applies if the plastic is poured cold and is subsequently heated to effect the condensation. In the latter instance, the time of heating should also be taken into consideration, the number of casts from each mold varying inversely with time and temperature.

The reason for this is self evident. Pre-vulcanized latex is in many ways superior to and of longer life than the usual vulcanized rubber of commerce. On the other hand, any rubber is basically an organic hydrocarbon and as such, is subject to hardening or resinification when subjected to elevated temperatures for a long period of time.

Latex is the milky serum extracted by a tapping process from the rubber tree. It consists of a water emulsion

of rubber. Pre-vulcanized latex is the product obtained by concentrating latex, adding the necessary curing ingredients and vulcanizing while still in liquid form without coagulation or precipitation of the rubber. The type of product best suited for the manufacture of rubber molds has the consistency of a good grade of heavy cream. It is thus applicable for either brush, spray or dipping applications.

The dipping method is probably best suited for illustration where a small object is desired to be covered with a relatively thin coating of rubber. The rubber solution is stirred well, any bubbles formed should be skimmed from the surface, and the model to be coated should be dipped into the solution and withdrawn slowly. The rate of withdrawal should be approximately the same rate at which the solution flows down the object itself. In the event of too rapid withdrawal, an excess of solution is likely to accumulate at the point where the object leaves the rubber solution.

After the coating has been made, the model is placed in a warm room and allowed to dry. Drying is evidenced when the white liquid changes to a transparent or translucent tan color. The time of drying varies with conditions. If a drying chamber heated to approximately 170 deg. F. with circulating air to remove the evaporated moisture is available, the time to dry one coat should be less than 30 minutes. At room temperature without circulating air, the drying time is relatively longer.

When dry, the rubber coating will usually be found to have a thickness of 0.008 to 0.010 of an inch, which is ordinarily too thin for practical purposes. However, successive coatings may be applied indefinitely, drying between each coat until the desired thickness has been built up. When this has been accomplished and the coat dried, the mold is stripped from the form.

In the case of larger objects, even when built up to a fair degree of thickness, there probably will be some extension or distortion of the mold when the plastic is poured into it. Under such conditions, it may be necessary to cast a separable plaster shell around the finished rubber mold to hold it in position until the plastic has been poured and condensed.

After condensation has been effected, the plaster shell is opened, and the rubber mold stripped from the cast. In most instances, it will be found that a smooth though not highly polished surface results on the cast with much better definition than is the case when casting in materials other than rubber. The fluid nature of latex permits it to penetrate the smallest crevices. Using rubber molds, human hands have been reproduced with the finger prints sharply defined. (Please turn to page 64)

* Vultex Chemical Company.

JOLLY



Nineteen Jolly Gulp containers are first put into the Plaskon Filler Tray. Then the Plaskon Filler Top is placed on the Tray to permit quick and convenient filling of the small containers with a delicious frozen punch. Below—the Jolly Gulp ready for immediate delivery.

● The Jolly Gulp is a new and delicious frozen dessert. It is sold in a unique package that appeals especially to children. Its sponsors are the Pectin Industries, Inc. of Chicago, Illinois.

A part of the equipment used by retailers to make the Jolly Gulp consists of two pieces of molded Plaskon. These are called the Filler Top and Filler Tray. They are used to fill the clever cardboard containers in which the Jolly Gulps are sold. This Plaskon filling-unit is attractive, sanitary, durable, easy-to-clean. It has proved to be a most important contribution to Jolly Gulp's success.

When the Filler Top and Filler Tray are assembled, as shown on the opposite page, they measure 7" high by 8¾" in diameter with a trough that projects 2". The combined weight is two pounds. The molding material used is opaque white Plaskon which in this instance was found to be far more suitable than glass, metal or porcelain.



Y GULP?



*Photos, Courtesy of
PECTIN INDUSTRIES, INC.
Chicago, Ill.*

*Molded by the
IMPERIAL MOLDED PRODUCTS
CORPORATION
Chicago, Ill.*

Plaskon is the perfect plastic for the foods and cosmetics industries. It is tasteless, odorless, inert. Its surface is hard. It resists solvents — is impervious to oils and greases — is ideal for packaging salves and creams having bases of oil or grease.

Molded Plaskon is attractive to the eye, smooth and warm to the touch. It will not chip, rust, corrode. The white will not yellow — the colors will not fade. And because Plaskon is solid molded color, neither scratching nor abrasion impairs its color value.

Plaskon is available in unlimited color variations, from purest snow white through daintiest pastels and brilliant hues to jet black — and ranging from a high degree of translucence to complete opacity. These, and many other unique advantages, have made Plaskon the world's most widely used molding compound of its type.

Plaskon's facilities for research, design and engineering are at the disposal of any concern using or contemplating the use of Plastics. For complete information, write

2121 SYLVAN AVE.

PLASKON COMPANY

Incorporated

TOLEDO, OHIO

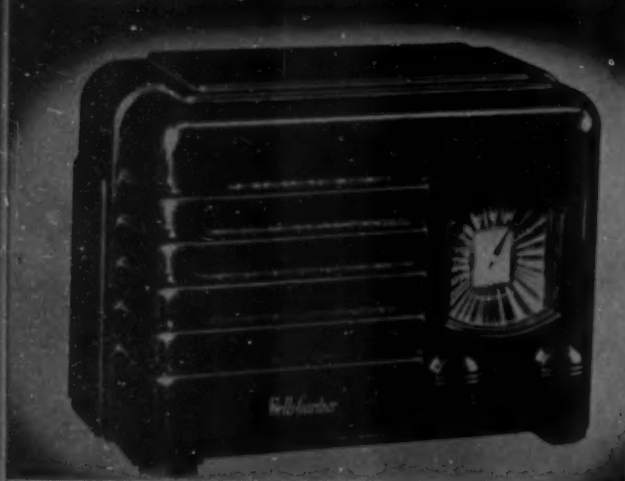
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PLASKON

★ M O L D E D C O L O R ★

Plastics in Review



1. The Wells-Gardner table model radio is housed in a walnut brown Durez case with control knobs to match. Gold cloth placed behind the grille harmonizes with the rich color of the plastic cabinet

2. For miniature camera fans, Bausch & Lomb Co. offers this Slide Viewer. With it, miniature films in black and white or colors, can be viewed without projector or screen. Auburn Button Works molded the Bakelite shell in two parts which fit together tightly to prevent light leaks

3. Shoreham Mfg. Co. fabricates its Twin-Rak poker chip set from Bakelite cast resinoid. The two halves of the set fit together neatly or may be separated for use while playing

4. High visibility of numbers features the dial on the Wurlitzer Record Player. Injection molded of Lucite by Erie Resistor Corp. the raised numbers are stamped black for contrast when the dial is back-lighted. All surfaces, except the numbers, are etched in the mold producing a translucent effect

5. Norton Laboratories, Inc., molds these high frequency crystal holders for the Bliley Electric Co. A special Durez material provides the high resistivity and low loss properties required for proper functioning of this type of frequency control

6. The Washburn Co. dresses up its household hooks with colorful urea plastic bases. Molded in yellow, white, black, green, blue or red, these can be chosen to blend with any household color scheme

7. Coaster cups grip the bottom of tall drink glasses and nary a drop of moisture falls on clothing or furniture. An absorbent paper lining fitted into a plastic cup does the trick. The red, green, ivory and black cups are molded of Tenite by Boonton Molding Co. for Coaster Cup Company

8. Molded Insulation Co. is molding simply designed flower pots, in color, from Durez. The smooth lustrous plastic surface is moisture-proof, doesn't stain, and fingermarks or smudges will wash off easily

9. The American Safety Razor Corp. has entered the electric razor field with its Gem Electric Shaver. The "works" are housed in a sleek, compact black case molded of Durez by the Waterbury Button Company



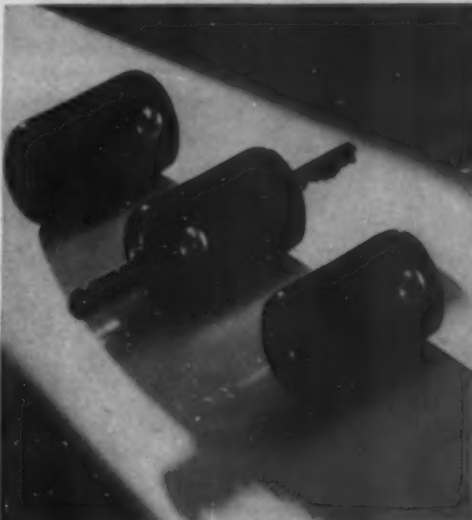
9

10. Amateur and professional photographers will find the F-R Interval Timer, now being marketed by Fink-Roselieve Co., an accurate check against under or over development of films. Black Bakelite is used for the knob and housing molded by T. F. Butterfield, Inc., and also for the supporting base molded by Specialty Insulation Company



10

11. Sliding pins hold two keys in place in this handy key case. Different shaped heads on the pins make it easy to distinguish the keys, by feel. Nelson Mfg. Co. is molding the cases of Tenite



11

12. Colt's Patent Fire Arms Mfg. Co. uses a special chemical resistant Durez plastic for the molded base of Carter's Cube-Well inkstand. A control valve in the well insures a smooth steady flow of ink from the bottle



12

13. A recent creation for the feminine motorist is this illuminatable Vanity Mirror, by Inspiration Products Co., to be carried in the glove compartment. Mirror and batteries are enclosed in a mahogany colored Durez case, molded by Reynolds Molded Plastics



13

14. Hamilton Beach Co.'s ice cream scoops have handles of black Bakelite molded, with a small colored button in the end. The color of the button indicates the size of the scoop. The handles are produced by the Molding Corp. of America



14

15. The Empire Hand Stamp consists of a metal die casting over which is injection molded a cellulose acetate coating. Tenite is the plastic material used for the coating and it is being applied by Chicago Molded Products Company



15

16. A black molded base, in contrast to gleaming chrome, distinguishes the new General Electric Automatic Toaster. The control knobs, as well as the base, are of Textolite



16

Plastics in Review



17



18

17. Sixteen air conditioned floors of Building #7 in Rockefeller Center are to be equipped with the Young Remote Control, a manually operated unit controlling individual room temperatures. Escutcheon and knob on the wall mounting unit are molded of brown Durez by Atlantic Plastic & Metal Parts Company

18. Different sized wire meshes can be inserted in the resilient injection molded handles and rims of Aristocrat Strainers. Commonwealth Plastics Co. molds them of Tenite for the American Strainer Corporation



19



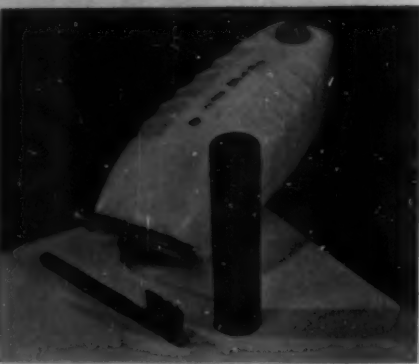
20

19. A vest pocket sport glass, as easy to carry as a cigaret case, has been designed by Bausch & Lomb Optical Co. A black molded phenolic body, modern in design, encloses 3-power glass rectangular in shape, which affords an exceptionally wide view rather than a high one

20. Stewart-Warner's Magic Keyboard Remote Control saves many steps. Placed within easy reach, stations can be dialed automatically by pressing a button. The control, designed by Barnes & Reinecke, is encased in a housing of walnut color Tenite, injection molded by Gits Molding Corporation



21



22

21. Scorch-proof ashtrays bear the trade mark and advertising message of the Schieffelin Co. The one shown is molded of Resinox by Plastic Products, Incorporated

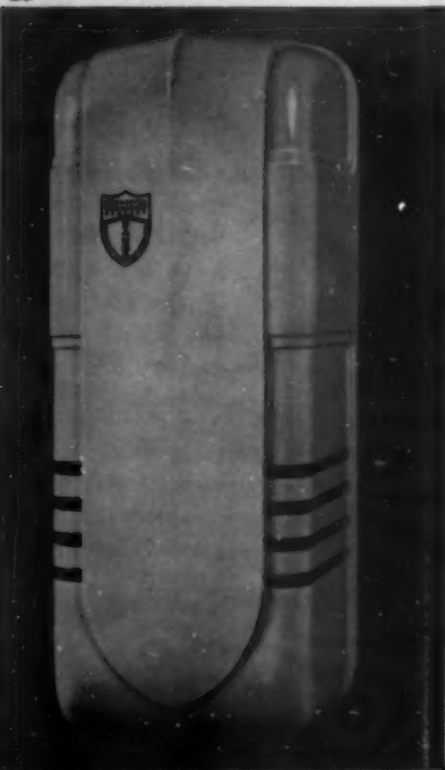


23

24



25



22. Included with each Nu-Era Whisker Shaver is a molded plastic vial of oil and a small molded cleaning brush. The red cap and black body of the vial are molded of Durez by Wheeling Stamping Co. for Electro Tool Co. The shaver itself is housed in a white Plaskon case

23. Over an indirect lighting plastic reflector, Wm. R. Noe & Sons, Inc., places a frosted white Lumarith shade. The red and white grograin ribbon edging at top and bottom of the shades matches the white marble pedestal and ruby red glass urn of the lamp base

24. Modernaire, an oil burning, free-circulating room heater, is the product of Globe Machine & Stamping Co. Styled by John Gordon Rideout and Staff, it has a tamper-proof black Bakelite heat control knob placed accessibly on the front panel

25. Rochester Germicide Co.'s Sanor, a disinfectant device for public rest rooms, is encased in white Plaskon. The smooth surface of the housing resists accumulation of dirt, the color harmonizes with tile interiors and will not rust, chip or peel. Norton Laboratories, Inc., is molding it

26. Coat hangers and curtain rods and rings in brilliant transparent colors are fabricated from Lucite by Joseph H. Meyer Bros. The ring at the upper left may be clipped onto a shelf to hold ties or scarves

27. Drop in a nickel and the mechanical Coca-Cola dispenser automatically mixes and serves a drink. Eugene Lux, who designed the dispenser for Lily Tulip Cup Corp. and Spacarb Corp., used translucent plastics for the lighted louvers and sign

28. All plastic is the "Twilite" night lamp offered by the Kirby Co. A cylindrical Larnicoid shade fits into a Tenite base and top molded by Atlantic Plastics & Machine Co. The socket is Bakelite molded

29. The Pickwik, an all-molded Candid camera, was produced by Monarch Mfg. Co. to sell in the lower price range. The case is molded in two sections by Industrial Molded Products Co., of non-fogging Durez

30. Here is a pouring device that automatically measures a predetermined amount of liquid, designed for mixing drinks. The cup is molded of Bakelite polystyrene by Mack Molding Co., for Mesurite Corporation

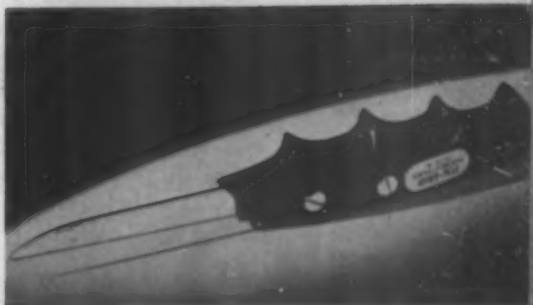
31. The handle of Fin-Grip, a household paring knife made by Wallie Foltz, is designed to fit the fingers. Parker-Kalon self-tapping screws fasten the Bakelite handle to the blade securely and permanently

32. Knit one, purl one—To glamorize knitting bags, the E. B. Kingman Co. is injection molding knitting bag handles in a variety of attractive colors

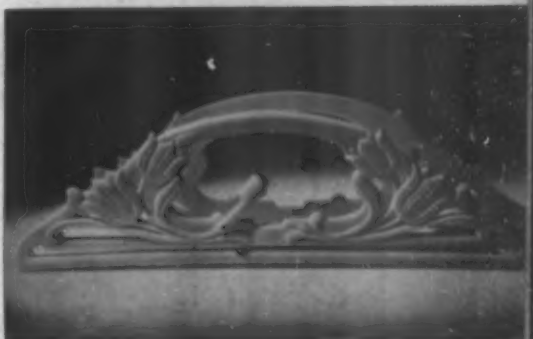
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28



COLOR SELLS LIGHT

A familiar appliance adds molded color to help speed home sales

IN FACTORIES, SHOPS, MINES AND AUTOS; WITH trainmen, boatmen, policemen and sportsmen, flashlights have long served as a handy source of portable light. Both in emergencies and in day-to-day use these familiar appliances have become almost indispensable. Small, light-weight and powerful, their beams have made easier many a job and saved many a life.

In the home, as well as in thousands of other places, flashlights have long occupied a valuable place. Dark cellars and unlighted staircases are made safer, and when ordinary lights fail through storm or accident, they stand ready as a reliable reserve. Realizing that flashlights are so widely used in homes and that women buy many of them, the Bright Star Battery Co., has designed a light suited primarily to the home and styled to appeal especially to women.

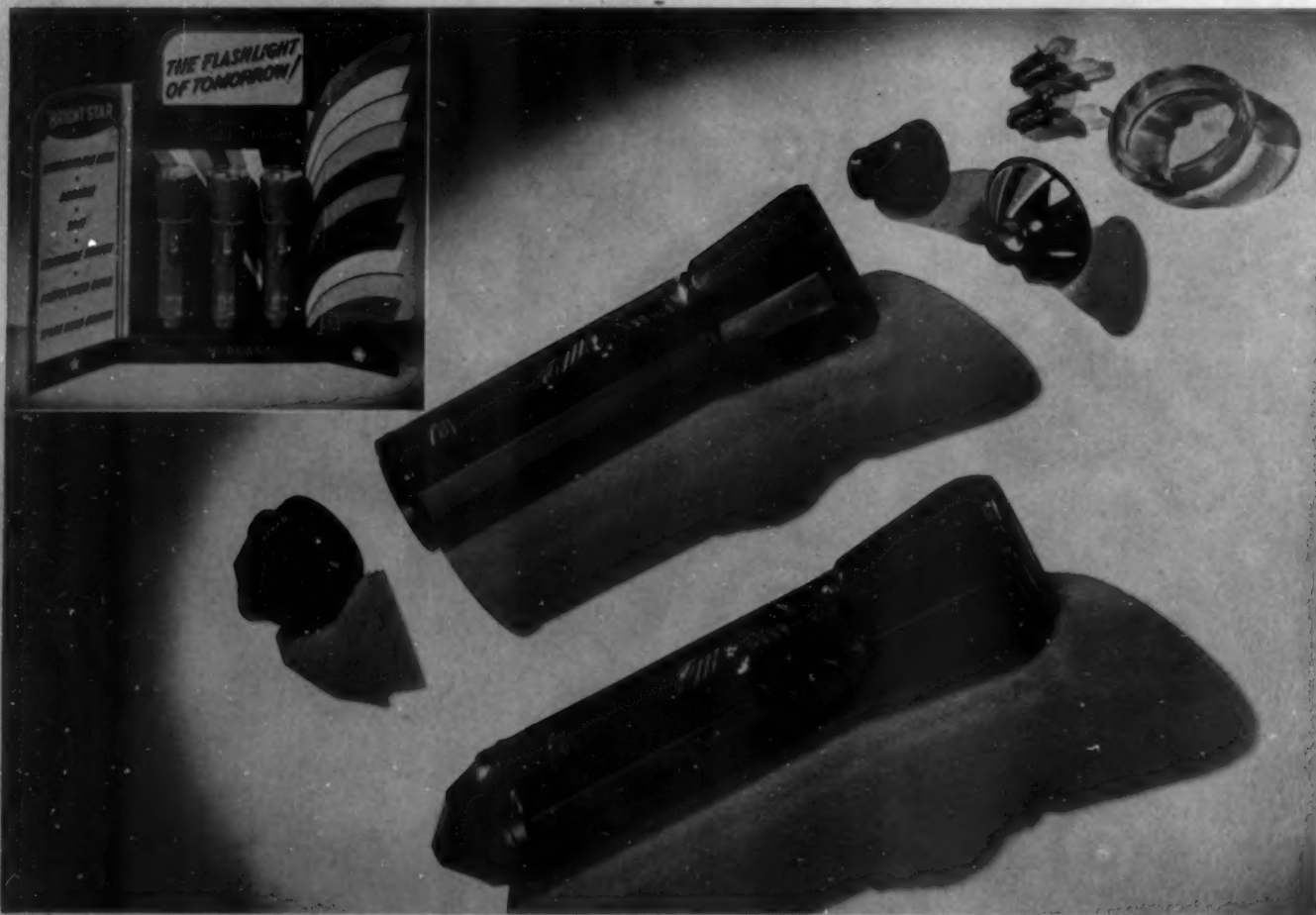
When design of the new light began, Anthony J. Desimone, company designer, decided that it must have more than is usually found in flashlights. Besides being reliable, durable and convenient, the new appliance must

be attractive and good looking. He found that the application of color to household appliances was enjoying wide success and that women were demanding things in bright, attractive shades. It was decided therefore, that the new flashlight for the home would be in colors.

From experience that the company had had in producing an industrial flashlight with a barrel and head of cellulose acetate, he knew that this material would stand up in hard use, that it was tough and resilient when banged or knocked around and dropped, and that it was adaptable to high speed injection molding. And he and his associates knew, too, that this thermoplastic material would give them an almost limitless range of color. But even with this plastic chosen as a logical, suitable material, the question of which particular colors would sell when used in flashlights remained.

To get the right answer, scientific literature, magazine articles and other data were searched for hints. Then 34 shades, ranging from orange to magenta, were chosen to undergo field tests. (Please turn to page 64)

Twelve attractive colors feature the new Bright Star flashlight (below) with all parts except the reflector and bulbs injection molded of Lumarith and Monsanto CA. A rainbow display (upper left) helps merchandise the colorful new light





Sheets One to Fifty-Two reprinted in book form, 25¢ in coin or stamps

STOCK MOLDS

SHEET SEVENTY-THREE

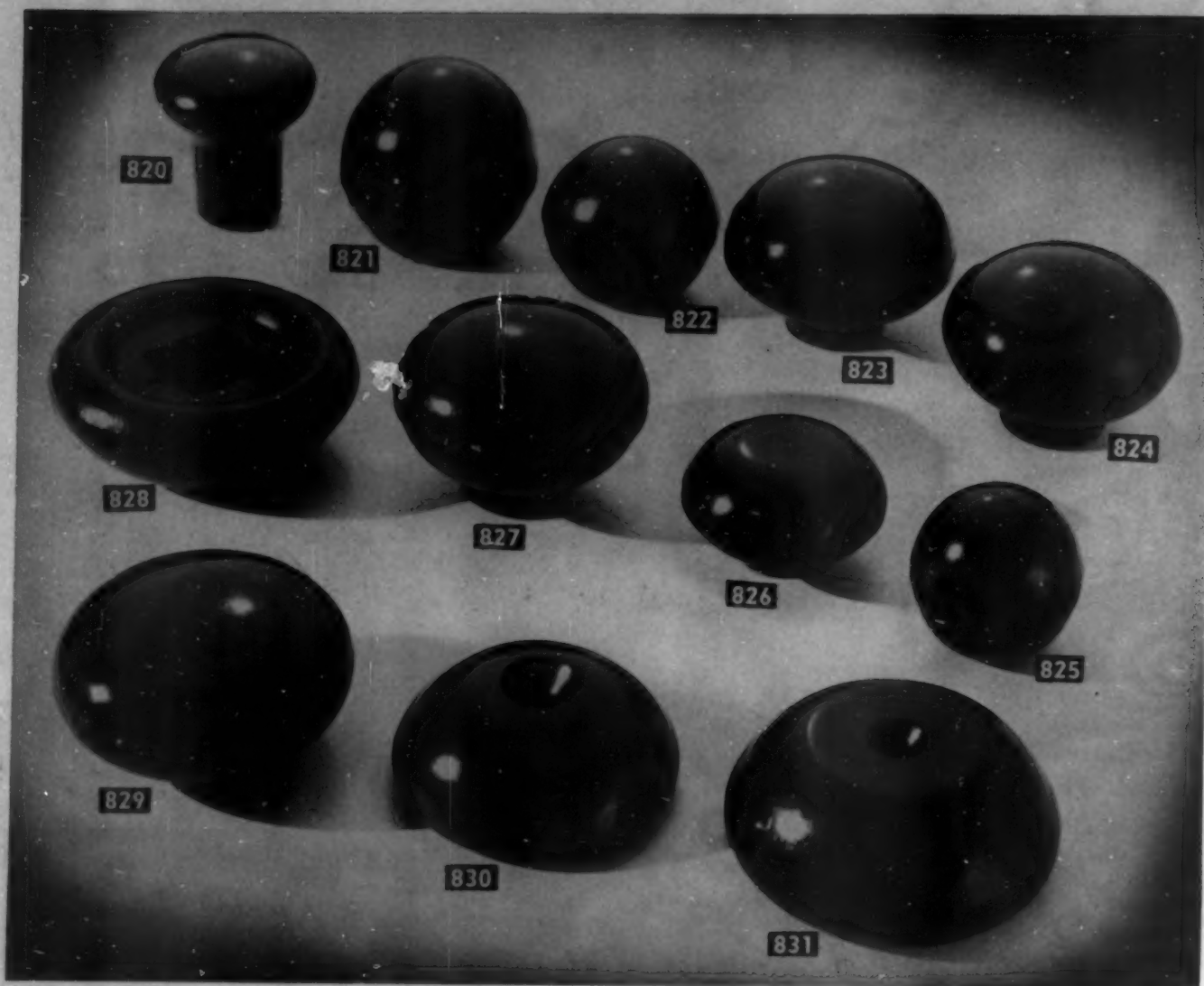
A radio cabinet, as well as a variety of knobs and handles, in addition to pen parts and decorative side pieces are available from stock molds. Molders' names and addresses will be supplied on request.

- 860. Handle 4 in. mounting centers. Overall length 5 1/2 in.
- 861. 7 5/8 in. handle with metal inlay stripe. 5 1/2 in. mounting centers
- 862. Handle with 2 3/4 in. mounting centers
- 863. Bar pull 1 15/16 in. long with 1 in. mounting centers
- 864. Fountain pen taper. The larger end has an outside diameter of 5/16 in.
- 865. Desk pen holder. It has a hole at the smaller end for threading and attachment
- 866. Plain handle 7 5/8 in. long with 5 1/2 in. mounting centers
- 867. 4 in. handle with two colored stripes, 2 3/4 in. mounting centers
- 868. Gas cock handle with escutcheon 2 in. in diameter
- 869. Gas cock handle with escutcheon 2 in. outside diameter
- 870. Gas cock handle with escutcheon 1 in. outside diameter and 2 in. overall length
- 871. Curved decorative side or cover handle 1 in. across
- 872. A smaller style of 871 but 9/16 in. across
- 873. Injection molded fluted crown knob which may be attached to a 1/4 in. shaft with a specially designed spring
- 874. Injection molded skirted knob, which takes a 1/4 in. shaft
- 875. Injection molded knurled cap knob, taking a 1/4 in. shaft



- 876. Red knob 11/16 in. in diameter
- 877. Same as 876 in white.
- 878. Knob, 1 in. diameter
- 879. Decorated knob 3/4 in. in diameter
- 880. Knob 5/8 in. in diameter
- 881. Plain curved handle 9 in. overall length, 6 in. mounting centers
- 882. Plain handle, 5 1/2 in. mounting centers
- 883. Gas cock handle 2 3/16 in. overall length
- 884. Gas cock handle 2 in. long, escutcheon 1 in. in diameter
- 885. Plain gas cock handle 2 1/8 in. long
- 886. Plain gas cock handle 2 1/8 in. long
- 945. Radio cabinet. The cabinet consists of eight molded parts which are assembled on the radio chassis with self tapping screws. A ventilating slot runs lengthwise along the top. The dial is not included. Dimensions are: 17 in. long, 7 in. from front to back and 9 in. high

Address all inquiries to Stock Mold Department, Modern Plastics, Chanin Building, N. Y. C.
All molders are invited to send samples from stock molds to appear on this page as space permits



Sheets One to Fifty-Two reprinted in book form, 25¢ in coin or stamps

STOCK MOLDS

SHEET SEVENTY-FOUR

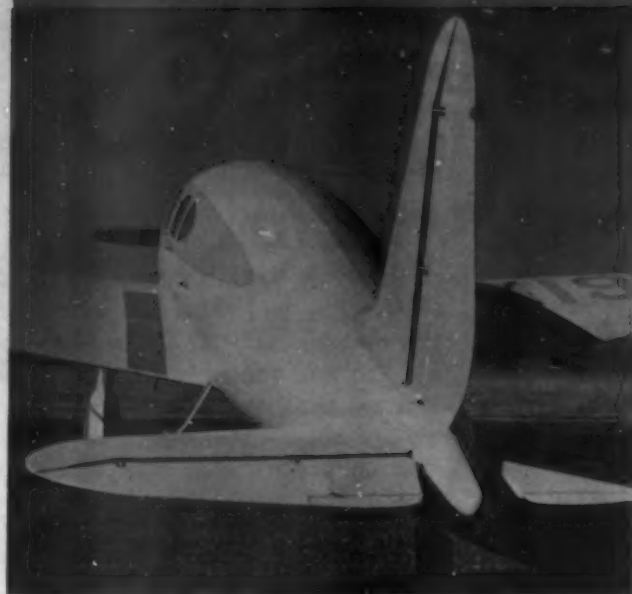
These valve handles, knobs and gear shift balls are available without mold cost from stock molds. The name and address of the molder will be supplied to interested executives who write on business letterhead.

- 820. Knob with threaded metal insert. The handle is approximately 1 1/2 in. long and the insert has a 5/16 in. inside diameter
- 821. Gear shift ball about 2 in. in diameter with threaded metal insert with 1/2 in. opening
- 822. Gear shift ball approximately 1 1/2 in. in diameter with 5/16 in. diameter opening in metal insert
- 823. Gear shift ball, which measures 2 1/4 in. in diameter and has a 3/8 in. threaded hole

- 824. Hollow gear shift ball. Available with top and lower part in different colors. The hole is 3/8 in. while the ball itself is approximately 2 inches
- 825. Gear shift ball with metal core that is 5/16 in. in diameter
- 826. Knob, 1 3/4 in. in diameter Metal insert has a 3/16 in. opening
- 827. Gear shift ball, with metal core with a 7/16 in. opening
- 828. Valve handle with round hole and square opening for a nut. 3 in. in diameter
- 829. Knob 2 1/4 in. in diameter with 1/4 in. opening
- 830. Valve handle 2 in. in diameter
- 831. Larger valve handle 2 1/4 in. in diameter

Address all inquiries to Stock Mold Department, Modern Plastics, Chanin Building, N. Y. C. All molders are invited to send samples from stock molds to appear on this page as space permits

Technical Section



The fuselage of this plane is molded of wood veneers and resin in two halves and cemented together at overlapping joints, by the Clark Aircraft Corporation. The close-up at the left shows the bonding line clearly

THE PLASTIC AIRPLANE

"Plastic" Airplane! "Plywood" Airplane! "Improved Wood" Airplane! These are terms that recently have been frequently seen in the press. The following remarks and items quoted from various sources may serve to clear up some misunderstandings regarding the distinctions between these three materials and reveal the progress that is being made in the application of synthetic resins to aircraft construction.—
G. M. K.

PLYWOOD IS, OF COURSE, A VERY FAMILIAR material and the fact that greater uniformity of properties is achieved by crossing the direction of the grain in the various layers is well known. It was in common use during the Great War in the fabrication of aircraft. The adhesives employed during that period were hide glue and casein cement, both of which are very susceptible to attack by molds, fungi and water. Today, synthetic resin adhesives of excellent bonding and moisture-resisting qualities are available. However, Brouse¹ found in studies made at the Forest Products Laboratory that although phenolic resin bonds in plywood did not soften or hydrolyze on continuous soaking in water for

4 years and were not attacked by molds after 4 years at 97 percent relative humidity, the mold-resistant glue line did not protect the wood itself from the action of wood-destroying fungi. These panels were exposed without protection by a surface coating or resin impregnation.

Concerning the use of wood in fabricating aircraft Warner² states that "As late as 1931, wooden and metal construction both had their advocates and there seemed to be no clear superiority for either above the other. In that year wood met with a crushing blow as an airplane material when a spectacular accident to a Fokker plane seemed to have been due to structural causes, and when subsequent interior examination of a number of wooden wings showed serious loss of strength by internal rot. Wooden structure was promptly and effectively banned. The condemnation may have been too hasty and too severe, for it is quite possible that protective treatments and waterproof adhesives can yet be found that will overcome the liability to deterioration that is wood's weakest point. With that overcome, wooden structures can be quite closely competitive in efficiency (at least in the small and medium-sized aircraft) with the best arrangements of metal now known."

Thus, we come to the "Improved Wood" which has resulted from the application of (*Please turn to page 66*)

1. Brouse, Don, "Exposure Tests on Plywood." *Mech. Eng.* 60, 852-6 (Nov. 1938).

2. Warner, E. P., "Technical Development and Its Effect on Air Transportation." Lecture delivered at Norwich University under the James Jackson Cabot Professorship of Air Traffic Regulation and Air Transportation, 1938.

LOW-COST MOLDING MATERIAL FROM AGRICULTURAL WASTES

by T. R. McELHINNEY, T. F. CLARK, and D. F. J. LYNCH*

Summary

Sufficient study has been made of plastics prepared from agricultural wastes, such as bagasse, to show that these materials offer a good potential source of inexpensive molding powders suitable for the manufacture of large, flat, or nearly flat, articles. Three methods of treating the ligno-cellulosic materials to produce molding compositions are proposed, none of which have been carried to a stage where the plastic exhibits an entirely satisfactory performance, although each product has properties to recommend its use.

Plastics produced by the first and probably the cheapest method, hydrolysis with acid, offer the greatest degree of moisture resistance but are somewhat deficient in strength. These powders in their present stage of development would probably be suitable for molding such articles as bathroom tile, where strength is not as important as water resistance. Although no test has been made of the wearing quality of these plastics, it should approach that of wood, and the fact that the finished pieces are subject to sanding and repolishing throughout their entire body, leads one to the conclusion that they would also make a very satisfactory floor tile. Waterproofing agents could be added where conditions of use warrant.

Pieces made by the second method, hydrolysis in the presence of aniline, were only slightly less water resistant than the best of those made from the acid-hydrolyzed powder and were much stronger. One specimen had a breaking test of 9000 lb./sq. in. The flow was not as good as in the case of the acid-hydrolyzed powders. Warping after molding seemed entirely absent. This powder seems adaptable to those uses proposed for the acid-hydrolyzed powder and would appear to have a much greater value as a structural unit, such as in construction of card table tops, desk tops, building panels, etc. In common with all these materials, it may be sawn, drilled, and tapped, and if care is taken, nailed. Tools of special steel would be required for drilling and tapping, since ordinary tools are quickly dulled. A carborundum saw will give good service for cutting. All these materials may be machined and polished. The size of articles molded commercially would be limited by press capacity, since this powder requires a pressure of 3500 lb./sq. in. for molding.

Products of the third, or sodium hydroxide-furfural method apparently have characteristics midway be-

tween the other two. Flow is very much improved and strength is excellent, with an individual specimen having a breaking strength of almost 7000 lb./sq. in. Moisture absorption was very high in the piece tested. However, there is some doubt that optimum conditions had been obtained. A sample prepared under reflux did not show any appreciably greater moisture absorption than the average of the acid-hydrolyzed powders. It is possible that some waterproofing agent will be necessary for special uses. This material is also suitable for the uses described for aniline powder and offers further extension of the size of the molded pieces, since satisfactory molding was secured at pressures as low as 2500 lb./sq. in.

Articles prepared by either the aniline or sodium-hydroxide-furfural method are very resistant to shattering when struck by a hammer or dropped, and even when struck with sufficient force to show surface checking are still very resistant to final breaking. Materials from the acid-hydrolyzed powders can be dropped from considerable heights without breaking, but have a tendency to shatter when struck.

Results of work done to date indicate that an inexpensive molding material can be manufactured from agricultural wastes. The molded products have properties varying with the method of preparation and are adaptable to many present-day uses.

Introduction

The rapid growth of the plastics industry has resulted in increased demands for some of the raw materials of manufacture, particularly for some of those used in the manufacture of alkyd and phenol-formaldehyde type resins. The output of synthetic resins has continued to advance, exceeding 160 million pounds in 1937, an increase of 20 percent over the 1936 production.¹ Coal-tar resins increased from 41 million pounds in 1933 to 116 million pounds in 1936² and 141 million pounds in 1937.¹ This resulted in an increased demand for, and production of, synthetic raw materials, the output of synthetic phenol increasing from 33 million pounds in 1933 to 43 million pounds in 1935. The resin industry consumed, in 1935, about 67 percent of the total production of synthetic phenol.³ Although it is possible that the output of synthetic chemicals can be expanded indefinitely to care for future demands, it seems unlikely that the price of these raw materials, and therefore that of the resins, can be materially reduced. Some of these raw materials, such as glycerol and phenol, are by-products of other manufacture, and the increased manufacture of these by-products might not be profitable in the absence of in-

* Agricultural By-Products Laboratory, Ames, Iowa, established by the Bureau of Chemistry and Soils, U. S. Department of Agriculture, in cooperation with the Iowa State College. The authors wish to express their appreciation to Dr. E. C. Sherrard and Mr. Edward Beglinger of the Derived Products Section, Forest Products Laboratory, Madison, Wisconsin, for their suggestions and the use of their equipment for a portion of the work reported in this paper.

1. Anon., *Modern Plastics*, vol. 15, no. 11, p. 41 (1937).
2. Eselen, Gustavus J. and Bacon, Frederick S., *Ind. Eng. Chem.*, vol. 30, p. 125 (1938).

creased markets for the main products. The cost of raw materials amounts to a greater percentage of the total cost of manufacture as the size of the molded article increases. With high-priced molding powders it is not possible, therefore, to produce large molded articles for extensive trade channels at competitive prices. A low-cost molding compound, made with the use of only small amounts of expensive chemicals, would greatly increase the application of plastics by permitting the expansion into broader fields, such as the manufacture of building materials and furniture. Moreover, this low-cost molding material could be substituted for uses where certain properties of the more valuable phenol-formaldehyde type of resins are not required.

Lignin plastic developments

Lignin, of which enormous amounts are annually thrown away as a waste product of our paper mills, and which occurs in even greater amounts in the stalks and stems of our annual crop plants, has for some years drawn the attention of various investigators as a source of cheap plastic material. In 1930, Phillips¹⁵ was granted a patent on the production of a resinous condensation product from lignin and furfural. A subsequent publication by Phillips and Weihe¹⁶ described condensation products of lignin with either furfural or various aromatic amines. Similar work by others has been summarized by Kline.¹¹

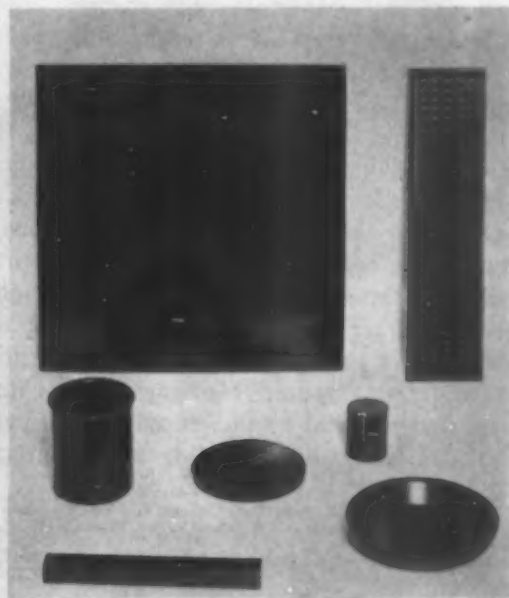
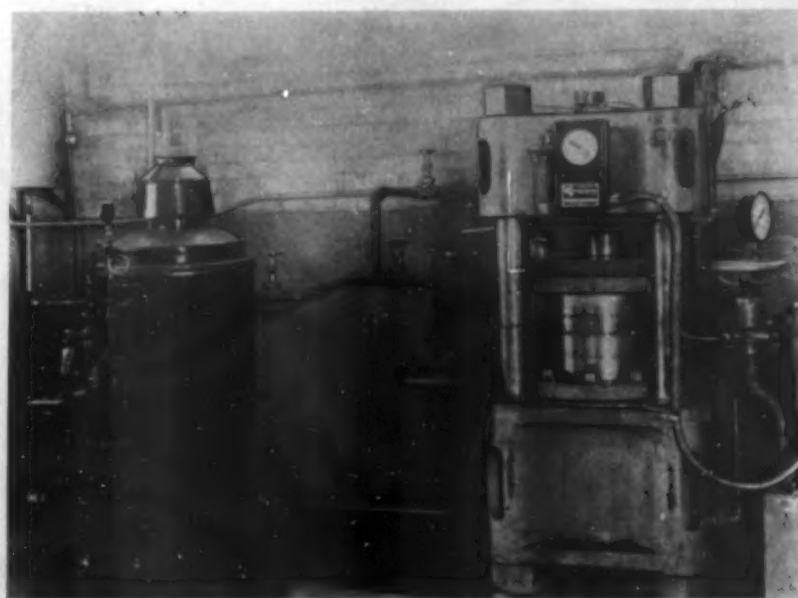
It appears from the descriptions of the above authors that lignin plastics would require large amounts of chemicals for their production. The subsequent washing, drying, and mixing with fillers is an involved and

expensive process. Workers at the Forest Products Laboratory, having in view the elimination of as many steps as possible in the preparation of molding compounds, several years ago conceived the idea of preparing lignin plastics *in situ* in ligno-cellulosic substances. In one method¹⁹ raw or partially extracted maplewood sawdust was mixed with a phenolic substance and a small amount of mineral acid catalyzer, and was molded directly under heat and pressure. Subsequent work resulted in a method²⁰ by which a plant fiber, preferably maplewood sawdust, was hydrolyzed with dilute sulfuric acid at 120 pounds steam pressure for 45 minutes, washed, dried, mixed with furfural or an aromatic amine, or both, and the resulting mixture molded under heat and pressure. Further developments described in a bulletin issued by that laboratory³ include: (a) digestion at 150 pounds steam pressure with 20 percent aniline, followed by admixing with water, and then molding; (b) hydrolysis for one-half hour at 135 pounds steam pressure with 1 percent by weight of sulfuric acid, followed, after washing and drying, by mixing with 8 percent each of aniline and furfural and one-half of 1 percent of zinc stearate (as a mold lubricant) in a rod or ball mill; and (c) chlorination instead of hydrolysis. All these processes give molding compounds having a moderate degree of flow. The resulting molded plastics are hard, jet black, and fairly resistant to water absorption and have good dielectric properties.

The production of a molding composition through use of the well-known Mason gun¹² is described in patents granted to Howard and Sanborn⁹ and to Mason, Boehm, and Koonce.¹³ The first of these patents deals with the use of the discarded fines from the wallboard process, and the second incorporates modifications such that all the plant fiber placed in the gun becomes suitable for use in molding. Essentially, the fiber is subjected to water hydrolysis at high temperature, following which the fiber is

8. Anon., Mimeograph R1134, Madison, Forest Products Laboratory (1937).
9. Howard, Guy C. and Sanborn, Lloyd T., U. S. Pat. 2,080,077 (1937).
11. Kline, G. M., *Modern Plastics*, vol. 14, no. 8, p. 39, and no. 9, p. 46 (1937).
12. Mason, William H., U. S. Pat. 1,824,221 (1931).
13. Mason, William H., Boehm, Robert M., and Koonce, Wilbur E., U. S. Pat. 2,080,078 (1937).
15. Phillips, Max, U. S. Pat. 1,750,903 (1930).
16. Phillips, Max, and Weihe, Herman D., *Ind. Eng. Chem.*, vol. 23, p. 286 (1931).
19. Sherrard, Earl C. and Beglinger, Edward, U. S. Pat. 1,923,756 (1933).
20. Sherrard, Earl C. and Beglinger, Edward, U. S. Pat. 1,932,255 (1933).

High pressure steam boiler and press used for molding bagasse plastics at Agricultural By-Products Laboratory, Ames, Iowa, are shown at the left. Some of the molded pieces appear at the right



"exploded" by sudden release of pressure. The resulting material is subject to molding after the addition of 1 to 11 percent moisture. Conditions are controlled to give the correct proportions of what the patentees describe as "resin-effect" and "filler-effect." Boehm⁶ describes more fully the production of a plastic product,* in which exploded fiber is formed into rough sheets and pressed. Water is the plasticizer except where certain qualities, such as high electrical resistance, are required.

Bailey⁵ questions the value of lignin as an adhesive in wood plastics. By microscopic study of samples of hard fiber boards from which the lignin and cellulose were separately removed, he decided that the adherence of fibers and the strength of the board were due to cellulose to cellulose attraction. Furthermore, he infers that lignin is of little value in plastics such as developed by the Forest Products Laboratory³ and that the strength of these plastics is due to hydrolysis of the cellulosic material before and during pressing. He substantiated his statements by experiments using fairly pure cellulose and paper toweling for forming very strong pressed board.

Although this is a principle which has been applied to the production of papier-mâché and Maizolith,⁴ Bailey's study has failed to differentiate between hard fiber board and true ligno-cellulose plastics. Hard fiber board, once made, is still subject to hydration and repressing, while the ligno-cellulose plastic cannot be remolded. The ligno-cellulose plastic is in an amorphous, insoluble, infusible form on which the solvents used by Bailey do not exhibit the action he describes. It is probable that in the hydrolysis and subsequent molding, even with no added chemicals, sufficient furfural is produced to react with the lignin and form a thermosetting resin in the presence of the acid catalyst. Results of experiments described below indicate, however, that the lignin resin does not possess a strength comparable with that of a pressed fiber board, and that as the structure of the molded product approaches that of fiber board, the strength of the molded article increases. This fact has been used to advantage and is discussed fully below.

The production of thermosetting cellulose resins, in which phenol and/or aldehydes are caused to react with cellulose under specified conditions of heat and pressure, is described in patents granted to Henkels,¹⁰ and Champer and Christensen.⁷

Of the various methods mentioned above, those of the Forest Products Laboratory appeared most promising for the production of a low-priced molding material from agricultural wastes; hence, work was inaugurated at this laboratory to study their application to various cellulosic farm wastes. Particular attention has been given to sugar cane refuse, or bagasse, one of the most abundant of those agricultural wastes accumulated industrially as a waste. Molding powders from bagasse were first prepared by the procedure used by the Forest Products Laboratory on wood; subsequently conditions

were varied in an effort to find those most suitable for bagasse and to produce a material suitable for industrial requirements. Details of the experimental procedures followed in the three methods of treating the bagasse which were studied, namely, acid hydrolysis, hydrolysis in the presence of aniline, and alkaline hydrolysis in the presence of furfural, and the results of tests on molded specimens prepared from the plastics thus obtained are presented in the Experimental Part of this paper.

Cost of raw materials

Determination of costs of digestion, washing, drying, and mixing was not within the scope of this study. It is, however, of some interest to note the costs of the raw materials entering into the preparation of these powders. A figure of \$8.00 a ton is taken as a fair price for bagasse delivered to the factory. Prices of other materials are taken from the current market quotations. The methods of calculating materials required and the costs for preparing 1 ton of the finished powders are as follows.

Hydrolyzed powder:

Yield of hydrolyzed bagasse	= 59.2%
Bagasse in finished powder = $\frac{100}{116} \times 100$	= 86.2%
Aniline = $\frac{8}{116} \times 100$	= 6.9%
Furfural = $\frac{8}{116} \times 100$	= 6.9%
Hydrolyzed bagasse required = 2000×0.862	= 1724 lbs.
Aniline required = 2000×0.069	= 138 lbs.
Furfural required = 2000×0.069	= 138 lbs.
Cost of bagasse = $\frac{1724}{0.592} \times \frac{\$8.00}{2000}$	= \$11.63
Cost of aniline = 138×0.15	= 20.75
Cost of furfural = 138×0.10	= 13.80
Cost of sulfuric acid = $\frac{1724}{0.592} \times 0.01 \times 0.00825$	= 0.24
Cost per ton	= \$46.42
Cost per lb.	= \$ 0.023

Aniline powder:

Yield (basis bagasse)	= 79%
Cost of bagasse = $\frac{2000}{0.79} \times \frac{\$8.00}{2000}$	= \$10.13
Cost of aniline = $\frac{2000}{0.79} \times 0.21 \times 0.15$	= 79.75
Cost per ton	= \$89.88
Cost per lb.	= \$ 0.0449

Sodium hydroxide-furfural powder:

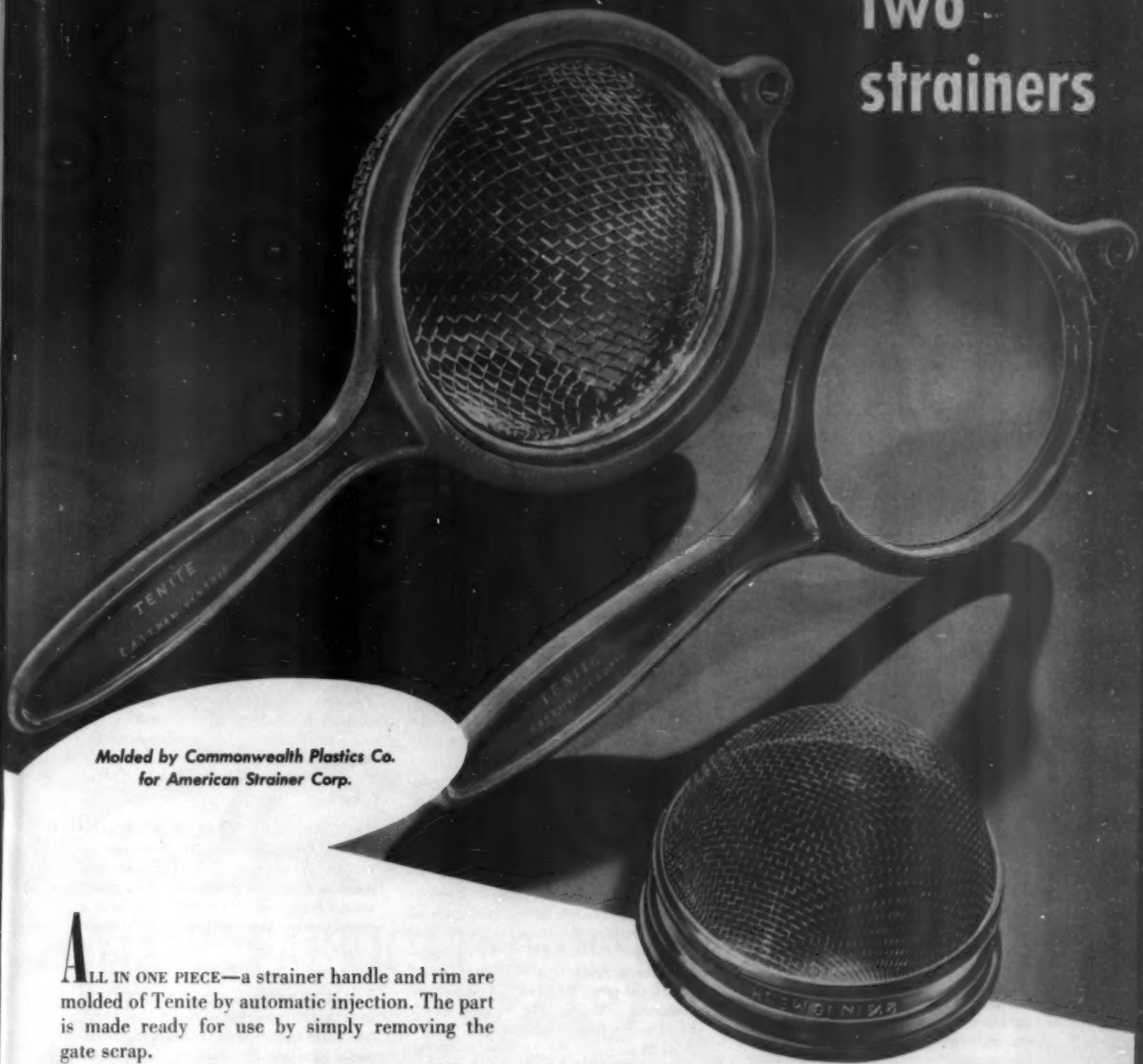
Yield (basis bagasse)	= 81.5%
Cost of bagasse = $\frac{2000}{0.815} \times \frac{\$8.00}{2000}$	= \$ 9.82
Cost of furfural = $\frac{2000}{0.815} \times 0.12 \times 0.10$	= 29.40
Cost of sodium hydroxide = $\frac{2000}{0.815} \times 0.15 \times 0.023$	= 8.47
Cost of sulfuric acid for neutralization + 10% excess = 495×0.00825	= 4.08

Cost per ton	= \$51.77
Cost per lb.	= \$ 0.026

(Please turn to page 70)

* "Benelite"
4. Arnold, Lionel K., Iowa State College, Eng. Exp. Sta., Bull. 113 (1933).
5. Bailey, A. J., Modern Plastics, vol. 15, no. 11, p. 39 (1938); Paper Industry, vol. 19, p. 1273 (1938).
6. Boehm, Robert M., Modern Plastics, vol. 15, no. 2, p. 86 (Oct. 1937).
7. Champer, Leon E. and Christensen, Leo M., U. S. Pat. 2,109,465 (1938).
10. Henkels, Max, U. S. Pat. 2,096,743 (1937).

A Single Tenite Handle sells two strainers



Molded by Commonwealth Plastics Co.
for American Strainer Corp.

ALL IN ONE PIECE—a strainer handle and rim are molded of Tenite by automatic injection. The part is made ready for use by simply removing the gate scrap.

The extreme strength and toughness of Tenite render the handle practically unbreakable. Its resilience permits easy insertion and withdrawal of the different-sized wire meshes—giving the housewife two strainers for the price of one.

The adaptability of Tenite to injection molding has simplified the design of many household utensils, giving them new beauty and serviceability at no extra cost.

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ence and beauty, and is available in an unlimited range of plain and variegated colors. A 52-page illustrated book on the properties and uses of Tenite will be sent on request.

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Plastics Digest

This digest includes each month the more important articles (wherever published) which are of interest to those who make plastic materials or use them

General

RECENT DEVELOPMENTS IN SOLVENTS AND PLASTICIZERS. E. H. Brittain. *Chem. Age* (London) 39, 524-5 (Dec. 31, 1938). The general trend has been modification of processes rather than development of new solvents. The production of acetone from propylene threatens to render uneconomic the fermentation process. The old-established plasticizers still maintain their position in spite of new substances appearing annually. By far the most extensively used plasticizers are camphor, alkyl phthalates and lactates, and the aryl phosphates, and their use seems to be extending rather than diminishing.

INDUSTRIAL UTILIZATION OF AGRICULTURAL PRODUCTS. *Ind. and Eng. Chem.* 31, 141-180 (Feb. 1939). A symposium of ten papers presented at the Milwaukee meeting of the American Chemical Society. The raw products of agriculture are essentially carbohydrates, proteins and fats. The cost of raw materials from coal and petroleum is much lower than from agricultural products. The latter can be used economically only if cheaper processing costs prevail or processes are not known for making the products from coal and oil. The titles and authors of the papers relating particularly to plastics are: "Plastic Materials From Farm Products," by G. H. Brother, "Cellulose Agricultural By-Products," by D. F. J. Lynch, "Utilization of Naval Stores," by C. F. Speh, and "Industrial Uses of Furans," by F. N. Peters, Jr.

PLASTICITY. F. H. Hanstock. *Chem. and Ind. (London)* 57, 1221-2 (Dec. 31, 1938). A theoretical paper on the relation of plasticity to mechanical behavior of plastics. Discussion of the paper, concerned mainly with the fundamental interpretation of such terms as "toughness" applied to molded products, will be found on pages 1105-6 of the Nov. 19 issue.

NOTES ON CELLOPHANE. J. E. Brandenberger. *J. Franklin Inst.* 226, 797-801 (Dec. 1938). A review of miscellaneous uses of Cellophane by the inventor of the machine for its continuous production. Some unusual effects produced by the addition of inorganic salts to the film composition are described.

PROGRESS IN INSULATION: 1938. J. R. Whitehead. *Elec. Eng.* 58, 23-31 (Jan. 1939). New insulating materials of the resinous and rubbery polymeric type are reviewed and a list of publications during 1938 is appended.

Materials and Manufacture

SYNTHETIC GLYCERIN. H. A. Levey. *Chem. Industries* 44, 143-5 (Feb. 1939). The

manufacture of alkyd resins and Cellophane consumes many millions of pounds of glycerin annually. Present source of this chemical is primarily the soap and fatty acid industry. Its production from sugars by fermentation and from propylene obtained by cracking petroleum is considered. The propylene is converted to 1, 2, 3-trichloropropane which hydrolyzes in alkaline medium to glycerin.

SISAL IN THE PLASTICS INDUSTRY. G. R. Eysen. *Plastics* 3, 32-3 (Jan. 1939). The use of sisal, jute and manila hemp in plastics suitable for industrial but not decorative applications is surveyed.

PROTEIN PLASTICS FROM SOYBEAN PRODUCTS. G. H. Brother and L. L. McKinney. *Ind. and Eng. Chem.* 31, 84-7 (Jan. 1939). Polyfunctional alcohols, particularly ethylene glycol, plasticize formaldehyde-hardened soybean protein. Monohydric alcohols, esters, ketones and oils gave negative results. Oleonic acid reduced the water absorption more than other water-repelling agents investigated. The minimum water absorption value reported for the protein plasticized with ethylene glycol and containing oleonic acid was 15 percent in 24 hours.

MODIFICATION OF LAC WITH ACIDS AND POLYALCOHOLS. B. S. Gidvani. *Chem. and Ind. (London)* 58, 10 (Jan. 7, 1939). The shellac molecule is assumed to have a molecular weight of 1,000 and 5 hydroxyl groups. The latter can be esterified with acids or etherified with alcohols. It is necessary to use unsaturated acids in order to convert the material subsequently to a nontacky film.

NYLON AND ITS IDENTIFICATION. W. Von Bergen. *Rayon Text. Monthly* 20, 53-7 (Jan. 1939). The physical properties and microscopic characteristics of nylon fibers are reviewed. One example of the production of such fiber-forming polyamides is given. Pentamethylenediamine (14.8 parts) is heated with sebacic acid (29.3 parts) and mixed xylenols (44 parts) for 13 hours in a nitrogen atmosphere at 218° C. The resulting mass is poured into a large volume of ethyl alcohol which precipitates the resinous polypentamethylene sebacamide, having a melting point of 195-6° C.

Molding and Fabricating

METALLURGICAL PROGRESS AND THE PLASTICS INDUSTRY. L. Sanderson. *Brit. Plastics* 10, 442-4 (Jan. 1939). Dies for telephone receivers are made of steel containing 2.5% nickel and 0.5% chromium. Compositions of various corrosion-resistant alloys are

cited. Monel metal pipes have proved highly successful for carrying steam to molds in place of brass piping which does not retain its shape.

Applications

CELLULOSE ETHER THICKENING AGENTS. A. J. Hall. *Textile Colorist* 61, 41-2 (Jan. 1939). One important use for such products is that of binding filling agents into textile fabric so as to resist washing. Fabrics thickened and weighted with starch agglutinants lose all their filling in the first wash, but those treated with cellulose ethers can be washed, often as many as 25 times, without losing much of the filling.

PROGRESS BECKONS TO MATERIALS AND METALLURGY. T. W. Lippert. *Iron Age* 143, 181-2 (Jan. 5, 1939). The manufacture of collapsible tubes from plastics in Germany is described. See detailed abstract in the News Section of this issue.

NEW METHODS IN PLASTICS. *Product Eng.* 10, 62-5 (Feb. 1939). A review of the uses of plastics in 1939 automobiles. Significant examples of new construction methods employed include instrument panels of laminated plastic-steel construction, combination of plastics with die cast parts, and new assembly methods employing spring steel clips snapped over integrally molded lugs. The capacity of injection molding presses has increased from 6 to 10 oz. last year to 32 oz. this year. Steel-cored steering wheels previously compression-molded at the rate of 3 per hour are now injection molded at the rate of 50 to 60 per hour.

REINFORCED WOOD FOR STRUCTURES. C. D. Phillippe. *The Aeroplane* 56, 77 (Jan. 18, 1939). Two laminated-fabric pieces 0.25 in. thick inserted in a 3 in. square wooden beam reinforced it so that 2 bolts in it proved stronger than 9 bolts in the wood alone.

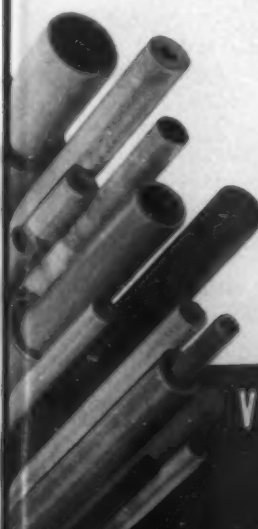
Coatings

FAST CURING SYNTHETIC FINISHES. E. H. Bucy. *Metal Ind.* 37, 19-21 (Jan. 1939). The latest revolution in finishes is the combination of a urea-formaldehyde resin complex with the proper fatty-acid-modified alkyd resin. The percentage of the UF complex may be varied from 10 to 80 percent of the soluble solids. The higher the UF content, the better the color retention, but the lower the gloss and the poorer the adhesion. The next phase of fast synthetic finishing is predicted to be the use of thermoplastics, such as modified vinyl resins and acrylic ester polymers, which require only removal of solvent and momentary exposure to 250° F. to produce surface flow.

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U. S. Plastics Patents

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PHOTOGRAPHIC STRIPPING FILM. G. F. Nadeau (to Eastman Kodak Co.). U. S. 2,140,648, Dec. 20. A stripping film on a temporary paper backing has a permanent water-permeable cellulose ester backing, joined to the paper by a water-soluble polyvinyl alcohol resin.

PIGMENTED LACQUER. R. T. Hucks (to E. I. du Pont de Nemours and Co.). U. S. 2,140,745, Dec. 20. Pigmenting a water-wet cellulose derivative with a water-wet pigment in an organic liquid medium, then colloidizing the mixture with a nonvolatile water-repellent liquid.

WRAPPING FOIL. E. Gebauer-Fuelnegg and E. W. Moffett (to Marbo Patents, Inc.). U. S. 2,140,835, Dec. 20. A flexible, greaseproof and moistureproof foil comprising glassine paper coated with rubber hydrochloride containing a chlorinated paraffin wax.

PLASTICIZER. H. A. Winkelmann (to Marbon Corp.). U. S. 2,140,868, Dec. 20. Plasticizing vulcanized rubber hydrochloride compositions with benzoyl benzoate esters.

VINYL RESIN SOLUTIONS. H. Rein (to I. G. Farbenindustrie Aktiengesellschaft). U. S. 2,140,921, Dec. 20. Acrylonitrile or acrylic acid polymers, or their interpolymers with vinyl compounds, dissolved in strong aqueous solutions of inorganic thiocyanates, iodides, nitrates or the like.

IMPREGNATING WOOD. P. C. P. and R. G. Booty. U. S. 2,140,981, Dec. 20. Vacuum impregnation of wood with a phenol-formaldehyde resin containing about 20% water and about 10% alcohol, then heating at atmospheric pressure to evaporate the water and alcohol and to set the resin in the pores of the wood.

MOLDING POWDER. C. Maters (to Hercules Powder Co.). U. S. 2,141,043, Dec. 20. Molding powder comprising hexamethylenetetramine and a fusible condensation product of pine wood pitch and an aldehyde.

VINYL RESIN VARNISH. A. K. Doolittle (to Union Carbide and Carbon Corp.). U. S. 2,141,126, Dec. 20. A stable, firmly adhering baking varnish is made with a vinyl chloride-vinyl acetate interpolymers, heat-stabilized with a lead salt.

FOILS. W. E. Catlin (to E. I. du Pont de Nemours and Co.). U. S. 2,141,169, Dec. 27. Making transparent foils from a synthetic polyamide material in a solution containing hydrogen chloride, and removing solvent from the foil.

VARNISH RESIN. J. B. Rust (to Ellis-Foster Co.). U. S. 2,141,197 and 2,141,198, Dec. 27. A resin which is color-stable in the varnish film, even in presence of driers, is made by condensing phenol or cresol with acetaldehyde and oxalic acid in presence of a drying oil.

WAX-RESIN BLEND. Harold Warp. U. S. 2,141,375, Dec. 27. A plastic material is made of rosin, ester gum or an alkyd resin blended with 10-30% of paraffin wax.

VARNISH RESINS. J. B. Rust (to Ellis-Foster Co.). U. S. 2,142,076, 2,142,077 and 2,142,078, Dec. 27. Light colored varnish resins are made by condensing phenol, cresol, xylene or cresylic acid with acetaldehyde in presence of oxalic acid, with or without a modifying agent such as tung oil, and bleaching the resulting dark resin by the application of heat.

ABRASIVES. A. L. Ball (to Carborundum Co.). U. S. 2,141,637, Dec. 27. Incorporating very finely divided abrasive particles in a liquid heat-hardenable resin binder.

TRANSPARENT HAT BOX. L. De F. Hokerk (to Kerk Guild, Inc.). U. S. 2,141,839, Dec. 27. A hat container having a lid, a flanged bottom and a side wall of flexible transparent sheeting, held at its bottom edge by an expander against the bottom flange.

CABLE. Wm. C. Hayman (to General Electric Co.). U. S. 2,141,910, Dec. 27. A cable for low voltage, heavy current underground network systems has the conductor wrapped in fabric impregnated with a tung oil modified alkyd resin, with a second wrapping of asbestos impregnated with chlorinated diphenyl.

ENAMEL. R. K. Hazen (to Egyptian Lacquer Mfg. Co.). U. S. 2,141,911, Dec. 27. A pigmented lacquer enamel contains nitrostarch and an oil acid modified alkyd resin.

ADHESIVE TAPE. A. Abrams and G. W. Forcey (to Marathon Paper Mills Co.). U. S. 2,142,039, Dec. 27. Reusable pressure-sensitive adhesive tape is coated with a composition of 15-60% cohesive and 10-30% adhesive agent, 5-45% plasticizer and 4-5% modifier.

GRINDING WHEELS. J. R. Erickson (to Norton Co.). U. S. 2,142,049, Dec. 27. New synthetic resin bonded grinding wheels are preserved, and improved in efficiency, by drying and sealing against contact with moisture until immediately before use.

PLASTICIZERS. E. F. Grether (to Dow Chemical Co.). U. S. 2,142,125 and 2,142,126, Jan. 3. Plasticizing cellulose derivatives with glycol aryloxyacetates in which the other hydroxyl group of the glycol is etherified.

SULPHIDE RESINS. J. C. Patrick (to Thiokol Corp.). U. S. 2,142,144 and 2,142,145, Jan. 3. Condensing disubstituted alkylene compounds with alkaline polysulphides to form polymeric sulphide resins which can be cured by heat.

COLD SEALING PASTE. Franzjokob Janz. U. S. 2,142,193, Jan. 3. A cold sealing composition contains cellulose acetate, chlorinated rubber, powdered asbestos filler, dyes, plasticizers and solvents.

CEMENT. A. Menger (to I. G. Farbenindustrie Aktiengesellschaft). U. S. 2,142,279, Jan. 3. Cementing solid objects together with a halogenated polyvinyl halide cement.

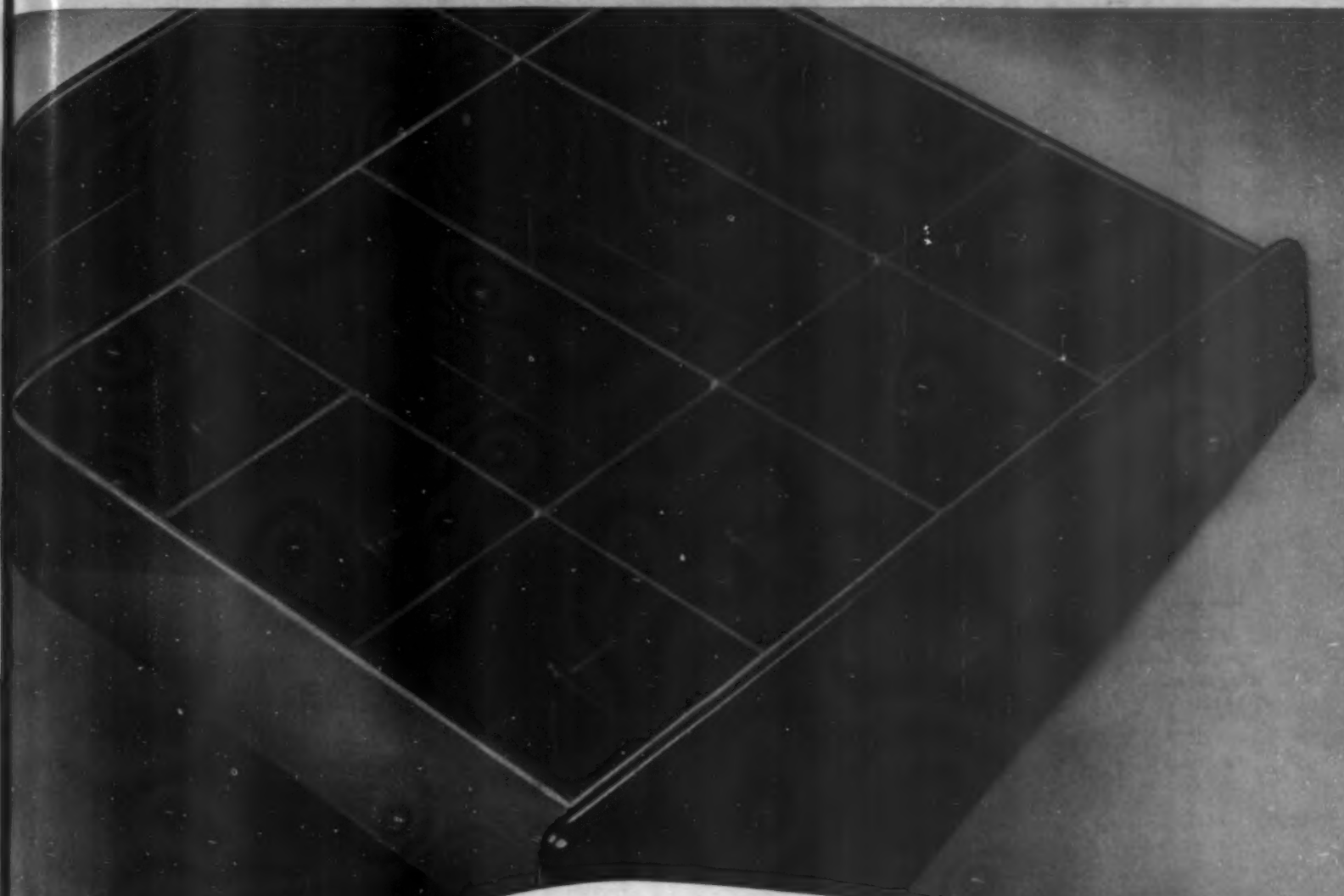
PRESERVING FABRICS. T. S. Carswell (to Monsanto Chemical Co.). U. S. 2,142,604, Jan. 3. Preserving fabrics against decay in water by impregnating the fabric with a phenol-cyclohexanone resin.

PREVENTING OFFSET. E. H. Bucy (to Atlas Powder Co.). U. S. 2,142,667, 2,142,668 and 2,142,669, Jan. 3. An antioffset composition for application to freshly printed sheets contains cellulose acetate or a cellulose ether in a blended solvent.

CIRCUIT INTERRUPTERS. V. Grosse; H. Schuhmann (to General Electric Co.). U. S. 2,142,840; 2,142,861, Jan. 3. The insulator confining the arcing device of a circuit interrupter is faced with a gas-producing synthetic resin, e.g., an amine-aldehyde resin, and wound with threads of a higher-melting alkyd resin; or the insulator is faced with an alkyd resin.

(Please turn to next page)

DURITE FURFURAL RESINS



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(Continued from preceding page)

RESIN. K. H. Benton and R. W. Work (to General Electric Co.). U. S. 2,142,833, Jan. 3. Making a resin composition from a natural resin, a vegetable oil and the ingredients of an alkyd resin and a phenolic resin.

STABILIZING POLYSTYRENE. Sylvia M. Stroesser (to Dow Chemical Co.). U. S. 2,142,968, Jan. 3. Stabilizing molded polystyrene shapes against surface frosting and checking by treating the surface with a solvent and vaporizing the solvent without allowing moisture to condense on the surface.

CREASEPROOFING TEXTILES. E. Koch, G. Schulz and A. Eckelmann (to I. G. Farbenindustrie Aktiengesellschaft). U. S. 2,143,332, Jan. 10. Creaseproofing textiles by forming an amine-aldehyde resin on the fiber.

MOLDING POWDER. C. Ellis, Jr. (to Plaskon Co., Inc.). U. S. 2,143,413, Jan. 10. Making a paste of powdered cellulose fiber and an initial urea-formaldehyde resin, extruding the paste, drying and then grinding it.

RUBBER-RESIN COMPOSITIONS. W. Becker and A. Koch (to I. G. Farbenindustrie Aktiengesellschaft). U. S. 2,143,470, Jan. 10. Compounding rubber with polyvinyl chloride or a chlorinated polyvinyl ester, or with chlorinated rubber, to a high chlorine content.

SLIDE RULE. A. W. Keuffel (to Keuffel and Esser Co.). U. S. 2,143,559, Jan. 10. Use of cellulose derivatives in making laminated slide rule scale faces.

RESIN COATINGS. P. C. P. and R. G. Booty. U. S. 2,143,618, Jan. 10. Coating articles with a liquid phenolic resin solution, extracting the solvent with a film of another liquid and setting the resin film by heat.

ALKYD RESIN. Wm. A. Hughes (to Harvel Corp.). U. S. 2,143,880, Jan. 17. Modifying an alkyd resin by heating it with cashew nut shell liquid.

SAFETY GLASS. G. Kränzlein (to I. G. Farbenindustrie Aktiengesellschaft). U. S. 2,144,067, Jan. 17. An interpolymer of vinyl chloride and another vinyl compound, as adhesive and interlayer in safety glass.

GLYCEROL RESIN. Wm. H. Butler (to Bakelite Corp.). U. S. 2,144,101, Jan. 17. A modified phenol-formaldehyde resin is made by condensing salicylic acid with formalin and dehydrating the product, then heating with glycerol.

FRICTION FACINGS. A. C. Teetsel (to Ferodo and Asbestos, Inc.). U. S. 2,144,234, Jan. 17. Friction facings comprising fabric rings impregnated with a liquid heat-hardenable resin.

WATERPROOF RESIN. P. D. Watson (to the People of the United States). U. S. 2,144,352, Jan. 17. Condensing lactylactic acid with a disaccharide and a modifying agent to form a waterproof resin.

MOISTUREPROOF FOILS. Walter König (to Rudolph Koepp und Co. Chemische Fabrik A.-G.). U. S. 2,144,703, Jan. 24. Moisture-proofing cellulose formate foil by swelling the foil in formic acid and coating with a varnish.

SEAMLESS TUBING. John P. Smith (to Visking Corp.). U. S. 2,144,899 and 2,144,900, Jan. 24. A thin paper tube with edges lapped and glued together is impregnated with a cellulose ether and passed through a precipitating bath to coagulate the cellulose ether.

AMINE RESINS. A. Hodler (to I. G. Farbenindustrie Aktiengesellschaft). U. S. 2,145,050, Jan. 24. Condensing acetaldehyde, propionaldehyde or butyraldehyde with a primary or secondary alkyl or aralkyl amine or a heterocyclic base, and condensing the product with formaldehyde.

POLYVINYL COMPOUNDS. Henry Dreyfus. U. S. 2,145,345, Jan. 31. Vinyl polymers, isomeric with polyvinyl acetates but having an ether instead of an ester structure, are made by etherifying polyvinyl alcohol with chloroacetic acid.

CABLE INSULATION. R. T. Haslam (to Standard Oil Development Co.). U. S. 2,145,350, Jan. 31. A plastic linear isobutylene polymer, with molecular weight above 1000 is used as an insulating coating on cables.

THERMOPLASTIC. E. Gebauer-Fuelnegg and F. E. Williams (to Marbon Corp.). U. S. 2,145,390, Jan. 31. A composition for molding or calendering is made of synthetic rubber hydrochloride, chlorinated paraffin wax, chlorinated diphenyl and a nonthermoplastic filler.

RUBBER HYDROCHLORIDE. H. A. Winkelmann (to Marbon Corp.). U. S. 2,145,412, Jan. 31. Compounding a phenol-aldehyde resin (40-75%) with rubber hydrochloride (25-60%) to form a tough, resilient, relatively nonthermoplastic resin.

ACIDPROOF VARNISH. L. V. Steck and F. A. Bent (to Shell Development Co.). U. S. 2,145,464, Jan. 31. An acidproof, alkaliproof varnish comprising a polyvinyl resin dissolved in an unsaturated ketone, without the use of any cellulose derivative.

MASTIC TILE. C. E. Fawkes and G. P. Heppes (to Tile-Tex Co.). U. S. 2,145,648, Jan. 31. Heat-molded tiles are made of blended para-coumarone resin and nitrocellulose, rendered compatible by adding a small proportion of cellulose ether, and reinforced by a fibrous filler.

WEIGHTING TEXTILES. Paolo Mattiottio. U. S. 2,145,695, Jan. 31. Weighting cellulosic textiles, while at the same time rendering them water-repellent and creaseproof, by impregnating with a partially condensed glucose ureide-formaldehyde resin and heating to complete the resinification.

VARIEGATED MOLDINGS. Wm. R. Moss and S. E. Palmer (to Eastman Kodak Co.). U. S. 2,145,887, Feb. 7. Nonwarping, non-shrinking cellulose acetate moldings are obtained in variegated effects by edge molding from a mass comprising several layers of differently colored plasticized cellulose acetate, without volatile solvents.

ALKYPHENOL RESINS. J. A. Arvin (to Sherwin-Williams Co.). U. S. 2,146,004, Feb. 7. Heat-hardenable resins are made by condensing formaldehyde with an alkylphenol in presence of aqueous alkali.

ROSIN MODIFIED ALKYDS. J. M. De Bell (to Hercules Powder Co.). U. S. 2,146,012, Feb. 7. Modifying alkyd resins with resin extracted from pine wood with a coal tar hydrocarbon solvent.

METHACRYLIMIDES. G. D. Graves (to E. I. du Pont de Nemours and Co.). U. S. 2,146,209 and 2,146,210, Feb. 7. Making resinous imides and amides of alpha-hydrocarbon substituted acrylic acids, the imides having long chain alkyl substituents on the nitrogen atom and the amides being derived from polyamines.

RESITOL. Fritz Seebach (to Bakelite Corp.). U. S. 2,146,234, Feb. 7. A resin which can be molded without added filler is made by grinding a resitol and milling with a little water on hot rolls.

OLEFIN-SULPHONE RESIN. G. H. Wilder (to E. I. du Pont de Nemours and Co.). U. S. 2,146,276, Feb. 7. Treating olefin-sulphone resins, not above 100° C., with vinyl acetate or chloride, or acrylate or methacrylate ester, or coumarin, furfural or the like.

TUBING. W. O. Herrmann, E. Baum and W. Haehnel (to Chemische Forschungsgesellschaft m. b. H.). U. S. 2,146,295, Feb. 7. Making extruded tubing from a polyvinyl alcohol gel prepared by evaporating a dilute solution down to 20-60% concentration.

UTENSIL HANDLE. C. A. Bradley (to Aluminum Cooking Utensil Co.). U. S. 2,146,415, Feb. 7. A two piece hollow Bakelite grip for utensil handles.

LIGNIN PLASTIC. E. C. Sherrard and E. E. Harris (to Henry A. Wallace as Secretary of Agriculture of the U. S. A.). U. S. 2,146,655, Feb. 7. Catalytically hydrogenating lignin to convert it into methanol and a fast-flowing thermosetting plastic.

RESINS FROM OILS. C. Ellis (to Ellis-Foster Co.). U. S. 2,146,671, Feb. 7. Condensing fatty oils with maleic anhydride and a polyhydric alcohol to form rubbery resins.

STEERING WHEEL. H. A. Husted (to Thermo-Plastics, Inc.). U. S. 2,146,703, Feb. 7. An automobile steering wheel is made of a metal frame covered with a molded plastic.

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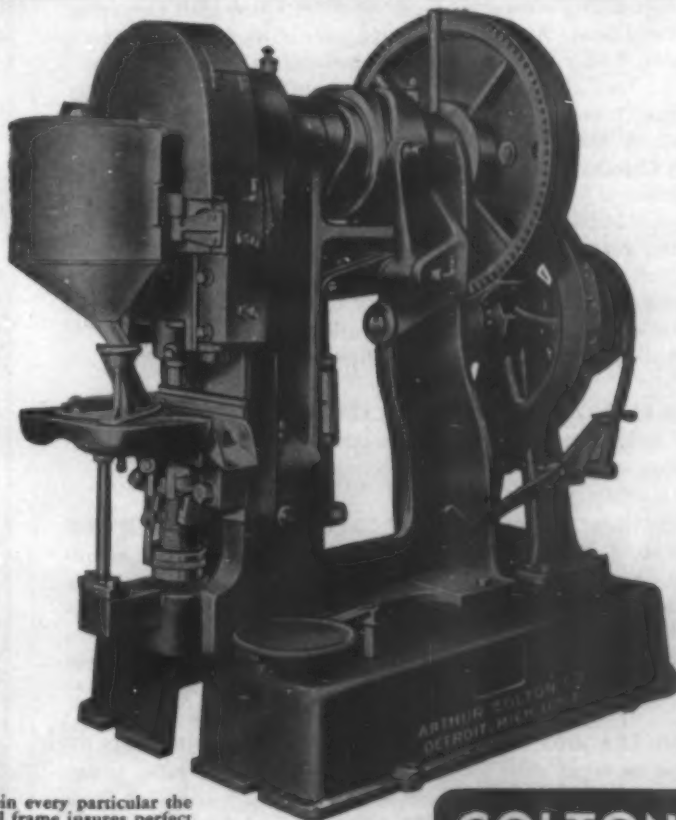
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DETROIT**

News

THE SCHEDULE OF FUTURE BOOKINGS FOR "MODERN PLASTics Preferred," the motion picture recently produced by MODERN PLASTICS magazine, following that listed in the Feb. issue, reads as follows: March 6-7, Thompson Chemical Lab., Williams College, Williamstown, Mass.; March 7-9, Fordson Board of Education, Dearborn, Mich.; March 10, St. Paul Ass'n of Mining Engineers, St. Paul, Minn.; March 10, General Electric Co., Philadelphia, Pa.; March 10-11-12, Monsanto Chemical Co., St. Louis, Mo.; March 14, Lowell Chamber of Commerce, Lowell, Mass.; March 14, American Society for Metals, Minneapolis, Minn.; March 15, Meriden Foremen's Club, Meriden, Conn.; March 17, Engineers Club of Minneapolis, Minneapolis, Minn.; March 17, Manning, Bowman & Co., Meriden, Conn.; March 20, Toledo Scale Co., Toledo, Ohio; March 22, United Shoe Machinery Corp., Beverly, Mass.; March 23, New Orleans Ad Club, New Orleans, La.; March 24, Reed-Prentice Corp., Worcester, Mass.; March 27, Wekearny Club, Kearny, N. J.; March 28, Young Men's Club of Asbury Church, Tarrytown, N. Y.; March 29, Masonite Corp., Laurel, Miss.; March 30, Lionel Corp., Irvington, N. J.; March 31, W. A. Krueger Co., Milwaukee, Wis.; April 3-7, Junior Chamber of Commerce, Spokane, Wash.; April 5, Advertising & Sales Association of Spokane, Spokane, Wash.; April 5, New Orleans Public Service, Inc., New Orleans, La.; April 6, Kiwanis Club, Orleans, Ind.; April 10, Engineers' Club of Tulsa, Tulsa, Okla.; April 10, Tacoma Chamber of Commerce, Tacoma, Wash.; April 11, Electrical Board of Trade, St. Louis, Mo.; April 11, University of Tulsa, Tulsa, Okla.; April 11, Bristol-Myers Co., Hillside, N. J.; April 12, Associated Engineers of Spokane, Spokane, Wash.; April 13, Purchasing Agents Association of Washington, Seattle, Wash.; April 14, San Antonio Advertising Club, San Antonio, Texas; April 15-May 1, Board of Education, Akron, Ohio; April 15-16, Austin Chamber of Commerce, Austin, Texas; April 20, University of Washington, Seattle, Wash.; April 20, Harvey Talbot, New York City; April 21, Chamber of Commerce, El Paso, Texas; April 24, American Society of Mechanical Engineers, Seattle, Wash.; April 25, Englewood Junior High School, Englewood, N. J.; April 27, Agricultural & Mechanical College of Texas, College Station, Texas; April 28, N. J. Boxcraft Credit Bureau, Newark, N. J.; April 28, Salem Advertising Club, Salem, Ore.; May 1, Oklahoma City Chamber of Commerce, Oklahoma City, Okla.; May 2, Portland Chamber of Commerce, Portland, Ore.; May 4-15th, Motion Picture Service, Seattle, Wash.; May 4, University of Oklahoma, Norman, Okla.; May 5, University of Arkansas, Fayetteville, Ark.; May 10, Oklahoma City Advertising Club, Oklahoma City, Okla.; May 11, Fleischmann Laboratories, New York City; May 19, Industrial Designer's Alliance of Chicago, Chicago, Ill.; May 24, Board of Education, Highland Park, Ill.; July 14, Kiwanis Club, Amory, Miss.

THE RESINOX CORP., MANUFACTURER OF SYNTHETIC RESINS and molding compounds, announces the appointment of Charles Lichtenberg as vice-president of the corporation.

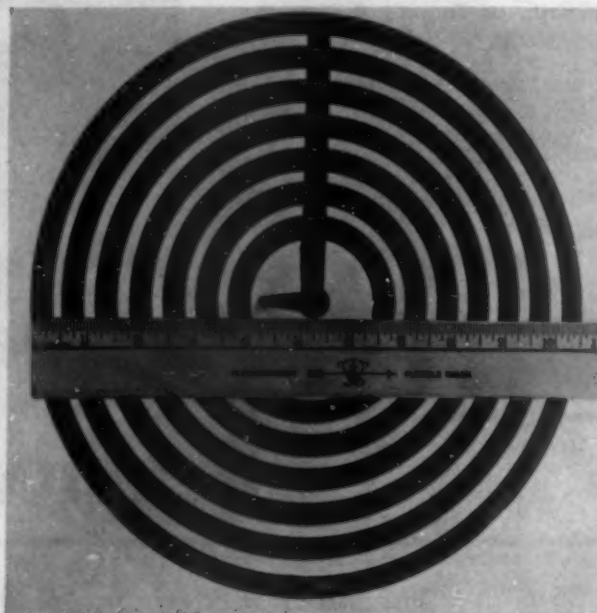
THE CHEMICAL ENGINEERING DEPT. OF THE UNIVERSITY OF Southern California, Los Angeles, announces an evening course in Synthetic Resins which will be offered on Thursday evenings from March 23 to June 8, 1939. This course will cover the chemistry, production and utilization of the modern synthetic resins and molding compounds, and will particularly emphasize the properties and limitations of the various plastics from the standpoint of their industrial applications.

NINE LEADING INDUSTRIAL DESIGNERS WERE INVITED BY *Vogue* to forget their streamlined locomotives, automobiles, household accessories and such for a bit and let their imaginations loose on a dress for the Woman of the Future. They did (one of them preferred to costume the Man of the Future, though) and their concoctions, in color, appear in the February 1st issue of the magazine. In designing their imaginative Clothes of Tomorrow, these experimentalists in fashion

chose modern materials. Things like Plexiglas, Polaroid, Glass yarn, Pliofilm, Lucite, Cellophane, Teca, Catalin, Lastex, and gilded Aluminum. According to *Vogue*, these costumes will be shown in windows of leading New York shops and will appear in a *Vogue-Parbé* movie.

S.P.I. IS PLEASED TO ANNOUNCE THAT IT HAS SECURED THE services of Stevenson, Jordan & Harrison, the largest statistical trade association organization in the world, for the purpose of collecting statistics from those plastic molders and material suppliers who are eligible by reason of company memberships in S.P.I. This has been done in conformity with the S.P.I. approval at the Manchester, Vt., Fall Meeting.

The Board of Directors of S.P.I. feel that it is to the interest of individual molders to join the other S.P.I. members who are now furnishing this information, with a view of making it as near 100 percent group action as possible.



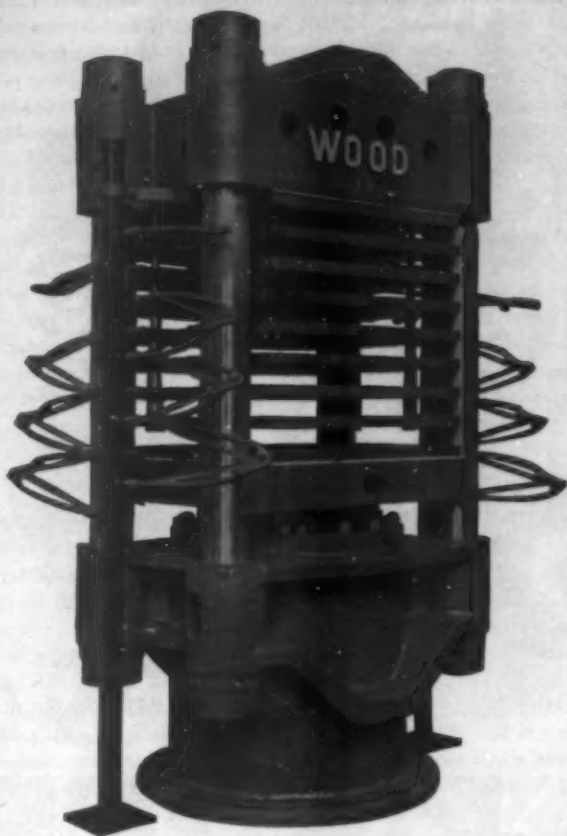
SIX OUNCES OF MATERIAL WAS INJECTION MOLDED INTO the test piece illustrated, through an orifice of $\frac{1}{8}$ in. The projected area is 62 sq. in., consists of 7 concentric circles injected from one runner which was $\frac{7}{16}$ in. wide and 0.10 in. thick. Each ring is $\frac{7}{16}$ in. wide by $\frac{11}{64}$ in. deep, with a sprue of $\frac{7}{16}$ in. tapered to $\frac{1}{8}$ by 3 in. long.

This is injection molded on the new 29-B, fully automatic, injection press recently announced by the Grotelite Company. The new press has a mass metal heater with a specially designed spreader to heat thin sections of material. Automatic control of feeding is accomplished with a feed selector and control system developed by this company.

JOHN P. CASE HAS BEEN APPOINTED MANAGER OF THE Plastics Department of The S. S. White Dental Manufacturing Co., Industrial Division, with offices at 10 East 40th Street, New York, N. Y. Mr. Case was in charge of plastics activities for Consolidated Molded Products Corp. for a number of years, resigning as president of that company a short time ago.

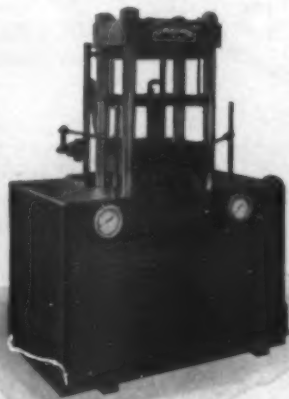
F. A. BRODEUR, GENERAL MANAGER OF U. S. PLASTIC CORP., Leominster, Mass., announces that I. J. Zellen has resigned as an officer and director of that company and that his duties have been taken over by J. Franklin Milles.

A SYMPOSIUM ON "TEMPERATURE AND ITS MEASUREMENT in Science and Industry" will be held under the auspices of the American Institute of Physics (175 Fifth Ave., New York, N. Y.), probably next fall, the dates to be announced later. Consistent with the title, the symposium will broadly cover many fields, its primary purposes according to present plans being to (1) coordinate the treatment of the subject in the sciences and branches of engineering, (2) review principles and bring up to date the record of recent work, (3) accumulate contribu-



HYDRAULIC PRESSES FOR THE PLASTICS INDUSTRY

Some presses that would be considered as "special" by others, are to be found in the standard line of the R. D. WOOD CO. Be sure to consult us regarding your press requirements.



(Above) An 8-opening, steam platen press operating on 2000 lbs. per square inch working pressure. Platen size—40" x 40".

(Left) A 50-ton Hydro-Electric steam platen press with self-contained pumping unit. Pumps, motor, valves and piping are fully enclosed.

ESTABLISHED 1803

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GENERAL J. E. B. STUART *Made a Fine Appearance*

This dashing Southern general, silver spurs on his boots and ostrich plume in his hat, was a romantic figure. No general of the Civil War possessed more courage or displayed finer leadership. His death at 31 was a blow to the Confederate cavalry from which it never recovered.



Plastics by
GENERAL INDUSTRIES
reflect splendor and charm

Where fine appearance is of first importance, as in articles designed for women's approval, for instance, you will find that General Industries molded plastics enhance any product.

High quality materials, modern equipment and careful workmanship contribute to make parts molded by General Industries all that the most critical production manager can desire.

Every engineer and purchasing agent with whom high quality, fine appearance and low costs are prime considerations will profit by submitting blue prints to General Industries. Accuracy and prompt deliveries are assured.

Send blue prints and specifications of the next job for quotations. No obligation.

GENERAL INDUSTRIES CO.

Molded Plastics Division

OLIVE AND TAYLOR STREETS

ELYRIA, OHIO

tions for a comprehensive text, to be published as soon as possible after the symposium is held, (4) reveal the subject as an important branch of physics and (5) supply schools with the information required for the improvement of curricula. The Institute confidently expects that a stimulating, valuable and unified program will be arranged, an aim which will require the help of many contributors.

Those who are interested in taking part in this symposium should communicate with the Institute at an early date, giving information regarding their field of work and the subject of the contribution they wish to make. Such contributions will be coordinated with the subjects of a group of invited papers, and assignments and divisions made.

LAKE ERIE ENGINEERING CORPORATION, BUFFALO, N. Y., manufacturers of hydraulic presses for all purposes, especially metal stamping and forming, has appointed L. E. Peck as Midwest District Sales Manager. He is located at 1540 East 53rd St., Chicago, Illinois.

DR. FRITZ POLLAK OF BELGIUM, A PIONEER IN PHENOL FORMALDEHYDE and urea resins, is making an extended visit to this country. Dr. Pollak's work is well known throughout the world. Between 1908 and 1930 he created some 240 patents on plastic materials which were sold at that time to the Pollopas groups. He has since devoted his time to research which he plans to continue here. Mrs. Pollak, also a chemist of note, is with him.

E. O. BEHNE, FORMERLY CONNECTED WITH THE DEFIANCE Machine Works, Defiance, Ohio, has entered the employ of the Reed-Prentice Corporation as chief engineer in charge of engineering and development. A. F. Schoepflin, formerly connected with the Doehler Die Casting Co. for a period of 30 years is now employed by Reed-Prentice Corporation as consulting engineer specializing in the die casting process including, brass, aluminum, zinc and magnesium.

FRED J. BACHNER PASSED AWAY AT HIS HOME IN CHICAGO on January eighteenth in his forty-ninth year. He was one of the five Bachner brothers, well-known in the plastics industry through their association with Chicago Molded Products Corporation.

PROGRESS BECKONS TO MATERIALS AND METALLURGY. "The World of Tomorrow" issue of The Iron Age (January 5, 1939) presents the following interesting remarks regarding plastics in a feature story having the above title. "In any discussion of tin plate it is always advisable to look into the possibility of the development of a competitive plastic substance for food containers. . . . That plastics are potentially capable of such a dramatic development is demonstrated by the recent German plastic used for making collapsible tubes on a commercial scale by Hafta Handelsgesellschaft für Technische Neuheiten, G.m.b.H., Berlin.

"The tubes are provided with heads (upon which the closing caps are screwed) made of plastic material and the caps themselves are likewise made of plastic. It is understood that a variety of plastic materials can be used for the heads and caps but that apparently the material now used for the heads is a carbamide (urea) synthetic resin and that used for the caps is polyvinyl chloride. . . .

"There were two main problems involved in producing the tubes and which previously had baffled all the research efforts of chemists concerned with the task of perfecting a plastic tube, namely, (a) the development of a suitable film for covering the Cellophane casing and (b) the firm attaching of the tube-head to the tube-body. It appears that both these basic problems have been effectively solved for the first time in the new tube. It seems that an important achievement was represented especially by development of a suitable resinous material that would remain permanently adhered to the Cellophane casing.

"The film casing is transparent, thus rendering the contents visible and enhancing their marketability. However, the tube casing can be covered with an outer-covering of opaque metal or other foil, or the casing itself may be printed in any manner desired, so that a wider variety of decorations of the tube and advertising effects can be achieved.

"The plastic tube is of feather-weight lightness, having only one-fifth the weight of tin-lead tubes. This lightness of weight enables considerable saving in transportation and other costs.

"The plastic tubes are claimed to be unbreakable and undentable so that the unusual care in packing them in the unfilled state, as is necessary in the case of metal tubes, can be dispensed with, with corresponding savings in charges for labor, packing materials, freight, etc., in shipping the tubes from the place of manufacture to the filling utilizing plant.

"The plastic tubes are said to greatly exceed metal tubes in flexibility and toughness and therefore there are no breaks in the casing due to rolling, creasing, tearing, etc., as are likely to occur with metal tubes.

"The tubes are especially useful in very large sizes of up to 500 cc. (approx. 1 pint) contents which would be quite impractical in the case of metal tubes owing to the prohibitively large amount of metal required, the resulting high cost of the metal tubes, the stiffness of the metal required for such large containers and the difficulties of folding or rolling such heavy metal tubes. It is believed that a particularly promising field of application awaits the new plastic tubes in very large sizes for containing all manner of industrial materials, oils, fats, chemical compositions, etc., for which very large size metal tubes have not been available heretofore."

The Editor, *British Plastics, Ltd.*: (Forwarded from England)

Re HYJECTA Injection Moulding Process for thermo-setting materials.

We understand that you have had several communications from British and American firms indicating that injection moulding of thermo-setting materials is "no news" to them and that it has been done by a number of firms for varying periods.

Our Principals, Messrs. Johs. Krause, G.m.b.H., of Hamburg, do not dispute this fact. No claim is made for the invention of injection moulding thermo-setting plastics but for the method and design of a Press and Mould to carry through this process in the easiest possible manner, trouble-free and without all the disadvantages experienced by the firms who are said to have experimented more or less successfully with the injection moulding process to their own design.

The HYJECTA Injection Moulding Process for thermo-setting plastics is the definite solution to the problem and not only have Messrs. Krause, as the result of the demonstration to the German trade, booked very substantial orders for HYJECTA Presses but several American Press Manufacturers have offered by cable to manufacture the HYJECTA Press under Licences in the United States. Further, on the 16th January, a demonstration took place in Berlin, attended by 8 British representatives of the best known firms in the trade, who were unanimous in their judgment that the HYJECTA Press is the solution for which the trade has been waiting.

The next demonstration under working conditions, will now take place at the Stand of Messrs. Johs. Krause, G.m.b.H. at the Leipzig Fair, Hall 7, Stand No. 239/221, from the 5th to the 13th March and the writer will be very glad to assist any interested firm with making the necessary arrangements for the trip.

Yours faithfully,

ATMER & BOOTH, LTD.,

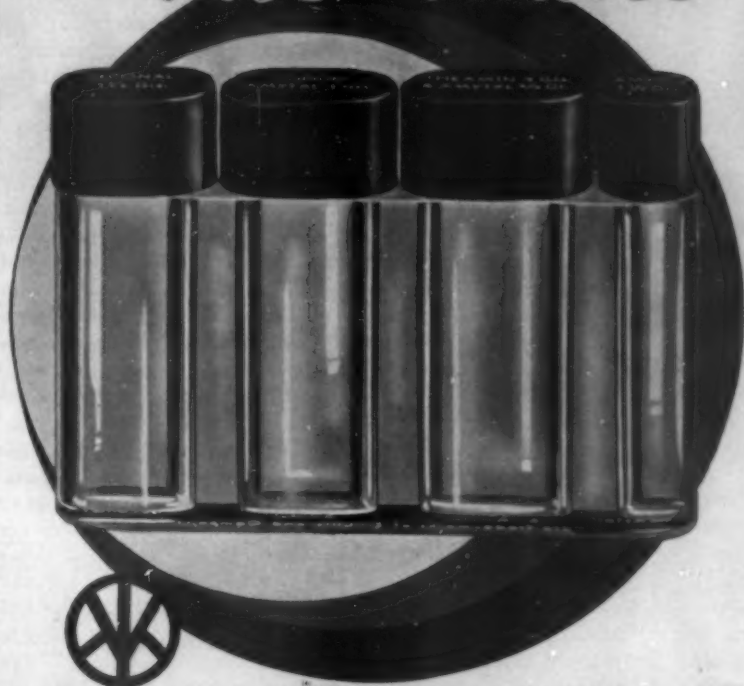
(Signed) H. ATMER, Director

BUSH HOUSE, ALDWYCH,
LONDON, W. C. 2

MONSANTO MAGAZINE (JANUARY ISSUE) SET A GRAND example to industry by refuting frequent allegations by pressure groups that "sixty families" control the assets of the country. Through an exhaustive survey, Howard A. Marple, Editor, was able to present the facts, so far as they relate to Monsanto Chemical Co., that thousands of people own, and millions have an interest in the company's ownership. Universities, life insurance companies and individuals were listed among the stockholders and it was pointed out that individuals included gas station attendants, secretaries, research men and women, nurses, salesmen, and others in moderate circumstances along with those of more abundant means. Intimate family pictures of many of these are shown indicating their home life; telling where they live and where they work; their hobbies and how they find happiness in life.

Such frank discussion of a company's position and ownership in the communities and in the country in which it operates cannot help but gain confidence among its workers and stockholders. Public relations assume tremendous importance in times like these. Intelligently handled it can do us all a world of good.

The Winner



MOLDED BY KURZ-KASCH

Here is the plastic container that won the highest award in the 1938 All-America Package Competition. It is a striking and compact capsule case for physicians in crystal clear Lucite . . . molded for Eli Lilly and Company, Indianapolis, by Kurz-Kasch.

For the different size pharmaceutical capsules, Kurz-Kasch created "wells" of varying capacities . . . with varied dimensions not influencing the outside contour. Each of the four black caps was molded with its own name and made in an individual size to prevent inter-changing.

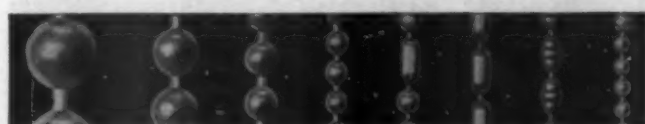
Here is a concrete example of the outstanding results being accomplished by Kurz-Kasch . . . made possible by specially designed machinery, skilled designers and experienced operators. It is the kind of result Kurz-Kasch is able to accomplish for you.

Let Kurz-Kasch handle the molding of your next plastic container or plastic part. Write today for necessary information. Kurz-Kasch, Inc., Dayton, Ohio

Branch Sales Offices: New York, Chicago, Cleveland, Los Angeles, Dallas, and Jackson, Michigan

KURZ-KASCH Inc.

INGENUITY



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DETACHABLE PENDANTS
AND SLEEVES FOR ALL
SIZES OF BEAD CHAIN
IN VARIOUS DESIGNS



CORD AND CHAIN
SPLICER AND
SLEEVE FOR
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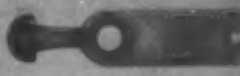
TYPE A
COUPLING
FOR 6-10-13
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FOR No. 10 CHAIN



END RINGS IN VARIOUS SIZES
FOR ALL SIZES OF BEAD CHAIN



TYPE A COUPLING HOOK
FOR No. 10 AND 13 CHAIN



SLEEVE AND COUPLING—OPEN
ASSEMBLED
No. 10-V CORD AND CHAIN CONNECTOR FOR No. 10 BEAD CHAIN



BEAD CHAIN* by itself is non-kinkable and strong, and with the ingenious application of such couplings and attachments illustrated above it has become a most effective and economical unit in many products.

BEAD CHAIN*

is now available in Monel Metal, as well as in brass, nickel silver and aluminum. Our 25 years experience is at your service in developing practical assemblies and units of BEAD CHAIN* for your products.

THE BEAD CHAIN MANUFACTURING CO.
60 MT. GROVE STREET, BRIDGEPORT, CONN.

* Reg. U. S. Pat. Off.

Publications

Write for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent postpaid at the publishers' advertised prices.

Toxicity of Industrial Organic Solvents

by Ethel Browning

Chemical Publishing Co. of N. Y., Inc., 1938

Price \$3.50

388 pages

In our December 1938 issue we reviewed two books relating to the technology of solvents. Here is a third book which should take its place with them on the desk of every individual concerned with the formulation of solvent mixtures for industrial purposes or with plant processes where such materials are employed. It is a report of the Industrial Health Research Board of Great Britain's Medical Research Council and comprises a very complete survey of the literature, widely scattered in various reports and scientific periodicals, as to the effects on animals and man of organic solvents.

Included within the scope of the review are the hydrocarbons, chlorine-containing compounds, alcohols, esters, cyclohexane derivatives, ketones, glycols, and a miscellaneous group composed of carbon disulfide, pyridine, and ethyl and isopropyl ethers. The section on each individual solvent is divided into a brief outline of its properties and uses, detailed information on its toxic effects, and a list of the references consulted in the preparation of the text. The book is outstanding not only as a compendium of existing knowledge for research workers in this field of toxicology but also as a practical guide to those concerned with the health of workers in solvent-employing industries. G. M. K.

Kunststoffe

by Franz Pabst and Richard Vieweg

VDI-Verlag G.m.b.H., Berlin, 1938

Price: 90 cents

92 pages, 51 illustrations

Again the prolific scientific press of Germany has brought forth another masterly synopsis of the present state of plastics in their country. This one fairly brims over with pride in the accomplishments of the chemist and engineer in providing by synthesis materials to replace those which Nature withheld. Progress to date, however, is considered to be but an augur of greater things to come. "Synthetic plastics have replaced iron in the manufacture of gears, bronze in bearings, ivory in billiard balls, rubber in tires and electrical insulation, brass in hardware, linoleum in floor coverings, copal in varnishes, alloys in printers' type, turpentine and fats in polishes, and cork in heat insulation. More important yet than these substitution problems are the technical possibilities existing in plastics which permit the solution of hitherto almost insurmountable difficulties."

The book is sponsored by the German Engineering Society as a manual of the industry, particularly for those making their first contacts with it and for use in educational institutions. Its subject matter covers the various commercial plastics and their raw materials, pressing technic, design and uses, and testing procedures. It is admittedly sketchy, but necessarily so in order to reach and retain the interest of those outside the industry who wish to become conversant with its present and potential scope without being confused by its complex ramifications.

G. M. K.

FEATURED IN THE 1939 SPRING COLOR COORDINATION CHART, just issued by the Textile Color Card Association, 200 Madison Ave., New York, N. Y., to its members, are the leading basic color ranges for costumes, swatched in silk and woolen materials, together with their correlated shoe, bag and glove tones in leather and hosiery shades in stocking material. Also illustrated are the smartest accent or combining tones with each basic color family. The stress on color in spring fashion promotions, as applied to costumes, millinery and accessories, renders this chart a useful guide to retailers, as well as manufacturers, in selecting and merchandising accessory shades in their correct relation to costume tones.

Synthetic Resins and Their Raw Materials

U. S. Tariff Commission Report No. 131, Second Series

Government Printing Office, Washington, D. C., 1938

Price: 25 cents

162 pages

A survey of the types and uses of synthetic resins, the organization of the industry, and the trade in resins and raw materials, with particular reference to factors essential to tariff consideration. Much of the information is presented in convenient tabular form in the 99 tables included in the report.

COLUMBIAN COLLOIDAL CARBONS. AN ATTRACTIVE AND interesting 193-page book published by the Columbian Carbon Company, New York, N. Y., describing the manufacture and properties of carbon pigments and reinforcing agents, 500,000,000 pounds of which are used each year in tires, printing inks, paints, plastics, and other industrial products. It presents an astonishing diversity of basic information on the colloid chemistry and testing of carbon and carbon-containing materials. After browsing through its pages, one is not surprised to find in the index such strange topics as "Angle of repose," "Confidence limits," "Chinese method of dispersion," "Draft control," "Discrimination," and "Sensitivity improvements," as well as the more orthodox listings of "Paints," "Rubber," "Plastics," "Plasticity," and the like. Some unusual photographs and drawings, 64 in all, assist in the dispersing of knowledge regarding the magic of colloidal activity. G. M. K.

A BULLETIN PREPARED BY AUTOMATIC TEMPERATURE CONTROL Co., Philadelphia, Pa., describes in detail its Vernier-set timers for industrial controls. Applied to automatic machinery, molding and extrusion presses, gas fired ovens and furnaces, these make possible accurate time cycles.

MICARTA, A MATERIAL ACTUALLY LUBRICATED BY WATER and unaffected by chemicals, is described for the paper industry in a new booklet being distributed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Penna. At least 150 pieces of Micarta may be used in a standard Fourdrinier paper-making machine, and the toughness and durability of the product eliminate costly shutdowns. One example of its durability is a Micarta toeblock in service in a New York mill for three years, with no appreciable wear.

THE ATLAS PRESS COMPANY GENERAL CATALOG FOR 1939, released recently, presents the most complete information ever available on Atlas lathes, shapers, drill presses, arbor presses and shop equipment. Twenty-four of its 72 pages are devoted to the new 10-inch Atlas lathes with power cross feed. Copies are available from Atlas Press Co., Kalamazoo, Michigan.

THE LOUIS ALLIS CO., MILWAUKEE, WIS., HAS PREPARED A condensed 8-page booklet including general information on NEMA Standards and Definitions. This booklet includes suggestions for the proper selection of motors, types of drives, various types of protected motors and their definitions; information regarding service factors, rated loads, torques and other important reference information.

THE SOUTH BEND LATHE WORKS, SOUTH BEND, INDIANA, has issued a 32-page catalog, No. 46-B, announcing its new model 9-inch workshop precision lathe. The 8 1/2 by 11 in., two-color book, has more than 150 illustrations describing and showing the different types, important features, workmanship and application of this backgeared, screw cutting, metal working lathe.

THE LAKE ERIE ENGINEERING CORPORATION, BUFFALO, New York, has made available a bulletin describing the applications and economies of hydraulic presses in the metal working industry.

"CRANE RESEARCH LABORATORIES" IS THE TITLE OF A NEW 47-page illustrated booklet issued by the Crane Co., 836 S. Michigan Ave., Chicago, Ill. The ways in which scientific investigation is applied to the manufacture of the company's line of valves and fittings is explained and the methods used described.

PRESSES *for* PLASTICS

450 Ton Semi-Automatic Molding Press. Completely self-contained with fully enclosed hydraulic power unit at rear.



60 Ton Self-Contained Molding Press of the semi-automatic type. Fully enclosed hydraulic power unit.



Watson-Stillman Molding Presses—plain types, semi-automatics, tilting head and angle presses—are all "engineered-for-the-job" by a staff of Engineers thoroughly familiar with every phase of press design and construction.

Our long experience qualifies us as experts in providing the exact type of press to do your jobs with greatest efficiency.

For any job of compression or injection molding get in touch with our Engineering Department. The Watson-Stillman Company, 118 Aldene Road, Roselle, N. J.

WATSON STILLMAN



Mark PLASTIC PRODUCTS . . .
FOR *lifetime* IDENTIFICATION . . .

EASY AS PRINTING

One single operation of a Peerless Stamping Press engraves the design or lettering into the surface of the plastic material and transfers the stamping foil at the same time.

PERMANENT AS ENGRAVING

Designs or lettering engraved by the Peerless Process do not rub off like printing. They usually retain their clean-cut appearance for the lifetime of the product.

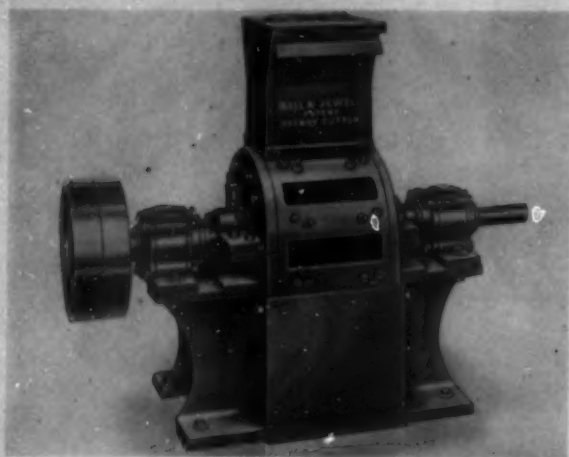
ECONOMICAL TO USE

A brass or steel die, a roll of Peerless Stamping Foil, and a Peerless Stamping Press are all that are required to mark your plastic items. Write for details. Send samples if possible.

PEERLESS ROLL LEAF COMPANY, Inc.

915 New York Ave., UNION CITY, N. J.

Equipment



NOW AVAILABLE TO THE PLASTICS INDUSTRY FOR REGRINDING waste and defective pieces, is an improved Patent Rotary Cutter, presented by Ball & Jewel. The laboratory model, illustrated, can be used to good advantage for capacities up to 175 pounds per hour, depending on the materials being reduced, and the fineness of the product desired. A new catalog recently issued shows a complete variety of rotary cutters made by this concern.

THE GROBET FILE CORP. OF AMERICA, WHICH LAST YEAR introduced its line of high speed steel flat drills for piercing small holes, announces a new line of Cylindrical Plug Gages for checking such holes. Gages are available immediately in diameters from .010 in. to .084 in. in every .001 in. They can also be obtained, on special order, every .0005 in. or .00025 in. or .0001 in., from .004 in. to .150 in. or in the metric system every 1/4/100 m/m from 0.25 m/m to 4.00 m/m. Double end gages, to check tolerances, can be made to order.



LINING PLASTIC JARS AND CONTAINERS WITH NON-POROUS silver electroplate is reported to eliminate any moisture absorption from the contents which might cause warping, swelling or cracking of the material under certain conditions. The impermeability of the liner insures freshness by guarding the moisture and flavor of the product. The containers illustrated were plated by Metaplast Corp. who worked out the technique and offer the necessary equipment for sale.

AN INSTRUMENT FOR AUTOMATICALLY MEASURING THE "on time" of alternating current circuits is announced by the Production Instrument Company. The Time Totalizer, as this instrument is called, consists of number wheels geared to a synchronous motor so that they record time in hours and tenths of hours. When connected in parallel with a motor, radio, X-ray or diathermy apparatus, lighting circuit or other alternating current circuit, the instrument automatically accumulates the total "on time."

THE FALSTROM CO. OFFERS A FULL LINE OF INDUSTRIAL OVENS INCLUDING truck-, monorail- belt-conveyor and special types used in the heat treatment of various materials. Methods of heating include direct firing, steam heat and electricity.

THE PREHEAT CO. HAS RECENTLY ANNOUNCED A NEW UNIT for preheating molding powders. The new unit is equipped with four rotating heated cylinders arranged in a horizontal position. Each accommodates a standard slip cover drug can, in which the powder to be heated is loaded where it is agitated to insure even heating. Thermostatic controls maintain constant temperature throughout the unit. Considerable savings in molding cycles are said to result from the use of the device.

LIGHTER IN WEIGHT AND OF IMPROVED DESIGN, A NEW keyless receptacle made of white Textolite has been announced by the General Electric wiring device sales section, Bridgeport, Conn. This device replaces the standard porcelain receptacle. The use of Textolite accounts for the lighter weight of the new receptacle, which is neat in appearance and has more wiring space.



HARDINGE BROTHERS, INC., HAS ANNOUNCED A NEW precision high speed tool room lathe. The new equipment features dove-tail carriage and bed construction which is said to minimize lifting action under operating conditions and result in more accurate work. Thread cutting is reported to be particularly simple on the new lathe. It is mounted on a fully enclosed pedestal, which contains motor controls, driving unit and storage space for tools and attachments.

BY ADOPTING AUTOMATIC COAL FIRING, THE SHEAFFER Pen Co. has found a way to achieve constant steam pressure with low-cost fuel. The company switched to automatically fired coal with the installation in its boiler room of two stokers of the Iron Fireman "Poweram" type. One of the stokers feeds a Frost high-pressure boiler, used for factory processing as well as for heating the office building. The second stoker is installed in a Kewanee low-pressure boiler, which heats the main plant. Coal for the stokers, being of the inexpensive small sizes, costs less than the lump coal previously required for hand-firing. The stokers burn 1 1/2-inch bituminous screenings. The maximum boiler pressure is 103 pounds, the stokers satisfactorily maintaining this margin.

A NEW MOTOR-DRIVEN HYDRAULIC PUMP CAPABLE OF developing pressures up to 30,000 lb. per sq. in. (2000 atmospheres), and a dead weight gage for measuring the pressures developed, are announced by the American Instrument Company. This pump is used for creating very high test pressures for determining bursting strength of cylinders and spheres; for operating high-pressure and hydraulic intensifiers; and for carrying out experiments to determine the effect of high pressures and sudden release on various materials.



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YOU SHOULD **REALIZE THE DIFFERENCE**

INJECTION presses and plastic materials have been widely publicized and discussed during the last four years. Much has been said of their advantages and uses. There has been a tendency, however, to lose sight of the important differences between the *various types of materials and the equipment for molding them.*

Materials, other than Cellulose Acetate, tend to change from a solid to a liquid and back to a solid, without going through the viscous stage. This necessitates *fast injection* at high pressures with *controllable speeds* and where necessary, *controllable pressures.*

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This means that we can close and lock the mold with any line pressure from 300 to 1000 pounds and at the same time, we can inject with an equal or lower line pressure on the injection cylinder.

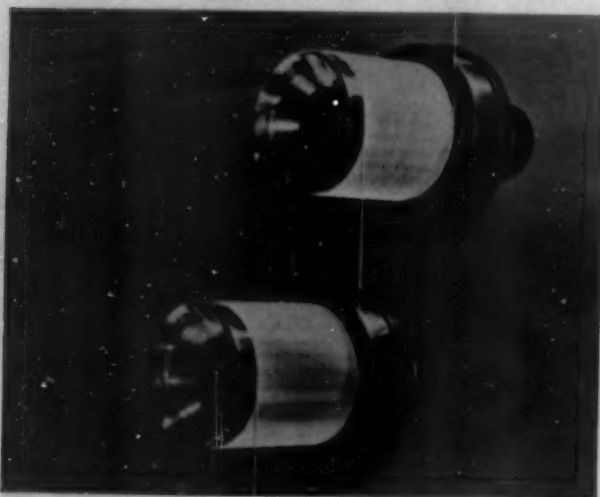
- ② Control of volume of hydraulic delivery during injection is such that any volume from one to over sixty gallons per minute may be obtained at line pressures from 300 to 1000 pounds per square inch on the 9" cylinder.

This means that material is moved during injection with a steady chosen pressure.

- ③ Control of power consumption is such that only a negligible amount is being used when no useful work is being performed.

PITY THE SHEEP

(Continued from page 23) bobbin. Thus there is no handling of the yarn from the time the viscose is forced through the jet until it is all wound up on the bobbin, ready for transfer to the coning room. All operations are continuous and automatic so that the finished yarn possesses a uniformity of fineness and physical characteristics that could not be guaranteed under the old, orthodox methods. And all this has been expedited by the development of plastic reel members on which the yarn is advanced at an accurate predetermined speed through all the processing stages. These reels are the handling medium for the continuous viscose rayon process.



All processing is accomplished as the thread travels from one plastic reel to the next in continuous production.

Development of the reel with plastic parts followed long and extensive experimentation in which a number of other materials possessing the required resistance to chemical action were tried. Some could not be molded satisfactorily and the weight of others was an adverse factor. When engineers of the Industrial Rayon Corporation and later those of Rayon Machinery Corporation, its wholly owned subsidiary, had agreed upon a plastic satisfactory for their purpose—continual subjection to the action of various chemicals—the problem of molding reel members from complex experimental models had to be faced. In collaboration with The Richardson Company, a simple precision-molded composite reel embracing two slotted drums or spiders, one inside the other, was successfully produced. These interlocking members revolve in the same direction with the inner spider having an eccentric rotation to give forward movement to the thread on the reel during spinning, or processing in which the entire surface of the thread is exposed to the action of chemicals and cleansers.

The importance of precision in the molding can best be appreciated by realization of the fact that any variation from the exacting tolerances specified would affect the speed of travel of the thread and its ultimate denier (diameter or gage). The spinning reels, which are located above the spin bath and draw the gummy filaments up

from the bath, for instance, have a stretching function which demands extreme accuracy. Designed as modified cones which flare outward from the driving axis, these reels stretch the yarn as it moves forward in successive wraps of increasing diameter. Dropping directly down from the reel at the discharge end of the spinning reels the threads of yarn pass down through individual tubes to the processing level where each strand passes over a sequence of eight additional cylindrical reels of the same composite plastic structure. At the base of this processing section, in which desulphurizing, bleaching, oiling and intermediate washing operations take place, each thread moves on to an aluminum drying reel of similar construction through which hot water circulates, and finally to the plastic bobbins at the base of the machine.

The reel assembly and other equipment for a single 100 end (thread) machine includes thousands of molded and laminated plastic parts.

With the Industrial Rayon Corporation plant at Painesville, Ohio, already in production with a large number of these machines in continuous operation and others bringing the plant's capacity to 12,000,000 pounds a year being installed, plastics are carrying the product through to completion.

In addition to the reels themselves, numerous other plastics molded and laminated were used throughout equipment in this new \$11,500,000 plant which is the first built to date for continuous production of viscose rayon. They include jet unions, thread guide holders and brackets, laminated gears and seal rings, molded bolts, nuts and washers, bobbins and other parts.

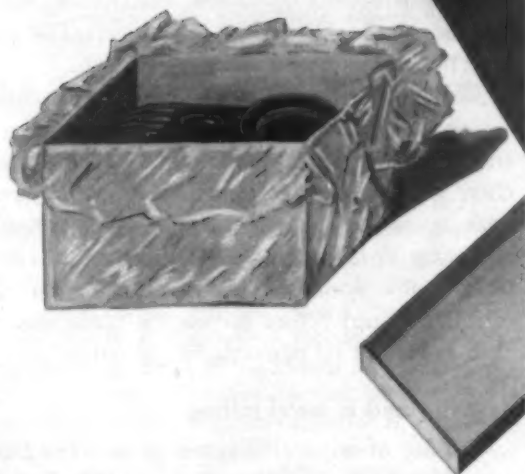
POWER HOOKUPS

(Continued from page 25) as horizontal lines), yet they show tops and right sides of models, as well as fronts. Assuming the model to be vertical when photographed, the trick is to move the camera until the lens is slightly to the right of and slightly above the hookup, twist the ground glass until it is parallel with the front plane of the model, move or swing the lens way down and left far enough to center the picture on the glass and finally stop down to at least F 4/5 to get a reasonably sharp focus despite all these liberties taken with the focal plane of the lens.

My editorial associates made all of the hookup assemblies. My personal job was to work out the general plan, develop methods, build fixtures and carve the equipment models. "Machine the models" might be a more accurate description, since most of the forming was done on lathe, sander, saw and drill press in my home workshop. This was my first attempt at plastic working, or at any sort of model making for that matter, although for years I have been familiar with metal and wood-working as a shop-trained practical machinist and a home-trained wood-worker.

To avoid reflecting surfaces, so troublesome in photography, the models were left unpolished. Simple sanding with medium-grit paper proved entirely satisfactory. If similar models were made for exhibition purposes,

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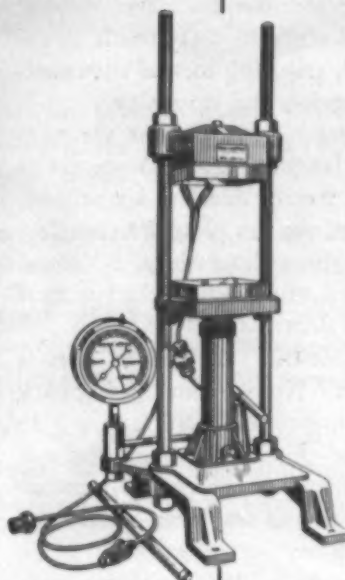
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rather than to be photographed, we would of course, polish them, both for better appearance and to preserve the smooth surface.

As mentioned at the start, soap, wax and wood were considered and rejected as model material. For repeated assembly, with metal rods forced into delicate flanges, soap would be entirely impractical and even hard wood could not stand the strain in certain sections. We found the full strength of the plastic essential for many thin parts subjected to "piping" stresses.

So far I have discussed this unique project mainly from the angle of those who may be interested in new uses for plastics. From the angle of engineers and engineering editors, we definitely *have something*. For years engineers have used hookup diagrams preliminary to actual power-plant design. These have become very complex. The confusion of criss-crossing solid and dotted lines tends to hide the main character of the hookups and makes it difficult to compare one arrangement of equipment with another. Such mental confusion may result in unwise design decisions, with resulting loss of thousands of dollars in plant construction and operation.

Speaking none too modestly, we feel that we have created a new engineering language from 20 pounds of plastic and a few hundred feet of dural and steel rod. Using this editorial medium, we can present a complete engineering story in the three dimensions of actual engineering rather than in a *flat* form which the eye must translate into its solid equivalent.

The individual models identify themselves after a single glance at the key page. No constant turning back to the key for symbol identification! No lettering to mar the pictorial impression! Each hookup photograph tells its own story of fluid flow and equipment interconnection. The brief accompanying text need merely tell where the particular hookup best fits and why.

Considering the time spent, our task was obviously very difficult, but it must be remembered that we produced *seventy* different assemblies. Taken in moderate doses, model making is easy. Almost any engineering organization could use an occasional model. Moreover, practically all engineering organizations include some men handy with tools who could make acceptable models and enjoy doing it.

The cost of large power plants runs into millions of dollars. If a hundred dollars, or a thousand, will save costly errors, the model money is well spent. After the plant is built models have a continuing use to give the operators an X-ray view of their own plant, which otherwise they can never view whole because of interfering walls and floors.

In closing, I yield to the temptation to step out of my field and, knowing very little about architecture, offer a tip to the architects. Isn't their's an ideal field for models made from plastics of suitable color and texture, rather than painted cardboard, wood and plaster? It seems to me that such models should help tremendously in *selling* the architect's conception of a structure to the lay buyer who not always quite trusts the blueprint or those pretty perspective sketches.

LAMINATED BEARINGS

(Continued from page 29) operation during the dry starting period and the greatly improved resistance of phenolic laminates to sand abrasion.

Ball mill bearings

About two years ago, a large manufacturer of cement equipped his tube mills with these bearings. The remarkable service records of laminated bearings in steel mills, furthered by the fact that he was desperate with the cost of upkeep of metallic bearings on these tube mills, were responsible for this application. The mills in question had never been able to operate more than two months on the best brass bearings obtainable, and besides the cost of bearings, production was stopped at each renewal, so that trunnions could be returned and trued.

After a careful analysis it appeared that the chief cause of the short life and high friction on metal bearings was caused by the fine cement always present in the air getting into the grease block and forming an abrasive instead of a lubricant. It thus seemed probable that a water lubricated bearing should constantly flush out the fine abrasive instead of retaining it on the bearing surface. Thus a single trial bearing was placed in the discharge end of one mill and the trunnions again smoothed up. After four months operation, the bearing was inspected and measured less than $1/32$ in. wear. The trunnion had been polished to an almost mirror finish.

Additional bearings were ordered for other mills and major changes made in the feed mechanism on the charge end, so that a water lubricated bearing could be placed there also. Today after more than one and one-half years operation the original bearing as well as those subsequently purchased are still in excellent condition and fit for many months of additional use. The trunnions—initially turned before use on the laminated bearings in each case—are all in excellent condition.

Bearings used in metal rolling

The use of laminated bearings in rolling steel, brass, copper, etc., is quite widely established and doubtless better known than other applications. The chief advantage gained in metal rolling is a marked decrease in friction averaging anywhere from 20 to 50 percent depending on the speed and pressures. In addition, marked increase in bearing life is obtainable with plastic bearings and an appreciable saving also made in the elimination of oil, grease and other lubricants. In normal rolling only water lubrication is used, and the degree of coolness with which these bearings operate has also taken care of another serious difficulty in metal rolling, namely, that of fire-cracks.

It is on roll neck bearings where the various changes in characteristics of laminated bearings obtainable by various additives are most useful. Thus it has been possible to develop a bearing for satisfactory operation particularly at low speeds where the maintenance of a water film is difficult. Other types are especially applicable where duty is particularly severe and bearing life has been in-

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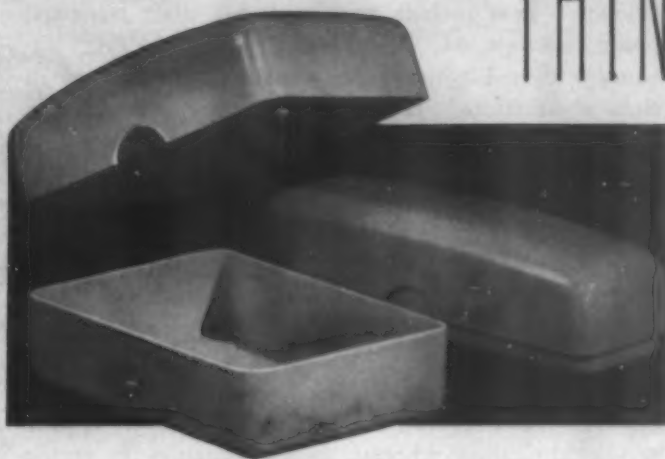


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creased over that formerly obtainable even with the best laminated bearings by as much as 500 percent.

Marine applications of laminated bearings

There are many bearings utilized in marine work where nothing except water lubrication is either practical or desirable. These include strut and tail shaft bearings, pintel bushings, etc. Laminated phenolic has every advantage over Lignum Vitae wood commonly used in these applications. It is strong and light, wears evenly and does not deteriorate nor crack during storage. It can be readily and economically worked and is most generally applied in the same housings where Lignum Vitae was formerly used.

Miscellaneous applications

There are numerous places in various industries such as paper, textile, milling, etc., where laminated bearings of various types can be used to excellent advantage. Some of these applications at heavier pressures require water lubrication whereas spindle bearings in textile mills are examples of uses requiring no external lubrication. In many cases sufficient oil can be incorporated in the bearing during manufacture to allow its use on light duty jobs without additional lubrication. Each new use requires careful consideration of all points involved such as obtaining adequate cooling for the bearing, proper lubrication, correct clearances, etc. Conventional metal bearing designs have in many cases to be radically changed but with a proper appreciation of the factors involved for the successful operation of a laminated bearing, the results generally far surpass expectations and well justify the expense of such alterations.

LATEX MOLDS

(Continued from page 31) If the plastic employed is not subject to polishing, where a high gloss is desired a lacquer finish appears to give good results.

The rubber mold is then replaced in the plaster shell and is ready for another casting. No definite figures are available at the present time for the number of casts obtainable from one mold. This depends to a large extent upon the temperature and time employed during condensation and also on the importance of the degree of definition required in each succeeding cast. Using cast phenolic resins, however, 40 or 50 casts are not unusual and much higher figures have been reported.

What has been said about the application of prevulcanized latex by dipping, applies equally well in connection with its application by brush or spray gun. The principle is to obtain the desired thickness, building up successive layers of rubber by superimposing one over the other. Brush applications are slow, likely to leave streaks from the brush, and the brush expense itself is a factor. But in certain cases, this seems to be desirable. Spray applications are usually more uniform than those applied by brush. Better definition can be obtained and there is, of course, no evidence of brush marks. The build-up of the rubber is, however, not as great as in the

other methods of application. Further, if the object is of irregular shape, there is apt to be a considerable loss of rubber during the spraying operation.

Two other alternative methods conducive to quicker build-up of the rubber mold are possible under certain conditions. If the original model can be made of plaster of Paris, the dipping operation is carried on by immersing the form in the solution, allowing it to stand there for an hour or more, removing and drying in the described manner. Owing to the absorbent nature of the plaster, the water in the solution is taken up by it, leaving a much heavier deposition of rubber on the surface than in the first illustration. Rubber films of $\frac{1}{8}$ in. thickness are not uncommon on one dip by this method.

A newer and even more interesting method where a metal or other heat retaining model can be employed, involves the use of a heat sensitized, prevulcanized solution. This process, contrary to the one just described, depends upon the sensitivity of the solution towards heat to acquire a rapid build-up of the deposited rubber. The metal model of the object to be reproduced in plastic is heated in hot water at approximately 200 deg. F. for the required period of time to bring it to that temperature. It is then immersed in the heat sensitized solution for a period of minutes only. In one instance, now in substantial production, a build-up of $\frac{1}{8}$ in. is obtained in about two minutes. If the model is of sufficient thickness to retain its heat for the required period of time after immersion in the latex solution which should be held at a temperature of approximately 60 deg. F., the build-up will continue correspondingly.

(Editor's note) It should be pointed out that phenolic resins in liquid form are tricky to handle at home. To assure the best results, rubber molds should be sent to a manufacturer of the resin so they can be filled under laboratory conditions at the proper temperature and cured in ovens with controlled heat.

COLOR SELLS LIGHT

(Continued from page 38) House-to-house surveys were made; dealers questioned; and finally the list was narrowed to 12. Checked by supplemental tests, these shades were selected to be featured in the new light.

With cellulose acetate chosen as the material, and colors selected, design of the flashlight itself began. Knowing the properties of thermoplastics, the designer was able to design the barrel and the head in one piece, and the head to combine the lens with the lens ring in one molding. A hollow cap, added to the tail, serves as an extra bulb-holder. Both the switch button and a ribbed socket for the tiny lamp are cellulose acetate; non-conducting and warm to the touch. A burnished metal reflector fits accurately into the molded head, and with a quick, sure assembly, the flashlight is complete.

To tie the color idea in with the retailing of the light, an eye-catching display in the colors of the rainbow is used. The display card serves at once to attract attention and as a sample card for the colors in which the flashlight is available.

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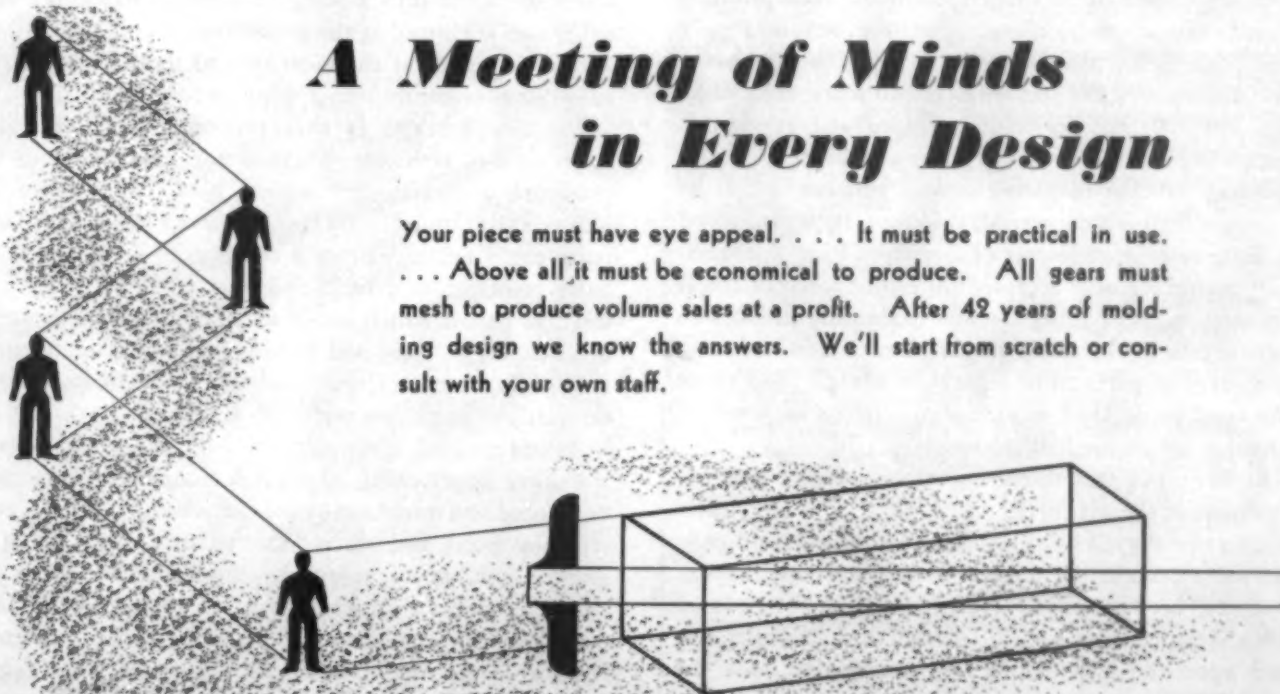
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THE PLASTIC AIRPLANE

(Continued from page 41) the protective treatments and waterproof adhesives hinted at by Warner. According to Gough,³ "Quite a number of different processes have been developed to produce these improved woods but most of these fall into one of two types. In the first type, synthetic resinous material is used primarily as a binding agent for thin veneers, being applied as a surface film, without previous impregnation of the wood subsequently subjected to pressure and heat. The resin content is much less than in the second method to be described and, on this account, better specific strength in tension and shear together with improved adhesion are obtained. In the second method, the synthetic resin is used as a filling material for the wood; much thicker plies being soaked (or vacuum impregnated) for some time in resinous material before being pressed. As both the resin content and amount of compression are controllable factors, within certain limits, the specific gravity of the final material can be made to vary from that of the natural wood, 0.75 for example, to an upper limit for which the value of 1.4 is rarely exceeded in practice. Veneers of different woods may be employed in combination, while the grain direction in these various veneers may be arranged as required."

With respect to the advantages and disadvantages of improved wood, Hart-Still⁴ notes that "Greater all-round strength is achieved by compressing and impregnating. . . . Further, the well-known objection connected with natural timbers, moisture absorption, is reduced almost to nothing. But the accompanying disadvantages are also very real. . . . The improved wood becomes harder and stronger and more difficult to work, but still has to be cut, shaped and assembled. Fixing one piece to another becomes a problem more pronounced than that of gluing natural timbers. . . . So far as production is concerned, therefore, improved wood has little to offer in respect of departure from the fabricating technique now accepted for either wood or metal construction. . . . Any attempt to simplify production must necessarily be made in the direction of reducing the number of parts to be separately made. And those parts must be finished in as few operations as possible, preferably by all-mechanical means."

This brings us then to the utilization of the "plastic" properties of the synthetic resins, that is to say, their ability to be shaped by the application of heat and pressure and to retain the desired form when the shaping influences are removed. As the previously quoted author⁴ states in his paper, "Production in plastics is based upon the idea of one fabricating operation for one finished part, the time for the operation

being reckoned in minutes rather than in man-hours."

Now it is obvious to everyone familiar with the properties of pure synthetic resins that by themselves they lack the strength and toughness to find application as structural materials subject to any appreciable stress. The use of a reinforcing medium (which in the ordinary molding compositions intended for non-structural parts would be called a "filler") is necessary in order to take advantage in aircraft construction of the superior surface smoothness, stability, low water absorption and ease of mass production of plastic products. To achieve the necessary strength the absorbent fibrous materials used for reinforcement must have an orderly arrangement as in a woven fabric instead of being distributed at random in the molded piece, as is the case for woodflour or ground-up canvas. Laminated plastics of considerable mechanical strength have been made commercially for many years, using paper and canvas reinforcement. In 1924 four papers of the National Advisory Committee for Aeronautics⁵ dealt with the use of this type of material in the molding of propellers. More recently wood veneers⁶ and thin cardboard-like sheets made of oriented wood fibers⁴ have been proposed as more suitable for the reinforcing agents in plastics to be molded into wings, fuselages and tailplanes. The properties of the former materials were reviewed by Kline⁷ and those of the latter are described by Hart-Still.⁴

Three methods of building aircraft of plastics have been proposed and are now being experimentally investigated. One involves the molding and assembly of a series of panels into a wing or fuselage structure; the other two are aimed at the production of complete wings and fuselages, or at the most two to three members for subsequent assembly into a wing or fuselage.

The first method is that proposed by Hart-Still.⁴ "An aircraft structure designed for plastics could be produced without every square foot requiring to be individually tooled. By careful attention very many parts could be made from a single tool or mold. The basic principle of plastic construction is to provide a series of panels which are in themselves complete structural elements, rigid and handleable, and accurate to a very high degree. These panels are produced in a single fabricating operation with all stiffeners and assembly locations molded integrally with the basic thin sheet, and have interlocking edges. Attachment points may be reduced to a minimum by local thickening of the sheet, whereby bolts and screws can be used in place of a greater number of rivets. Assembled, the series of panels produces a structural surface comparatively free from local imperfections. A structure so formed lends itself to inspection, maintenance and repair. The latter is facilitated by the simple replacement of a damaged panel; interchangeability is guaranteed by virtue of the molding principle. Moreover, this does not entail the use of highly skilled labor or complicated equipment as in the case of metal aircraft.

"In an example (Ed. note: hypothetical) of a single-motored fighter the ratio of molded area to tool area is approximately 11.5 to 1, and in the case of a twin-

3. Gough, H. J. "Materials of Aircraft Construction." *J. Roy. Aero. Soc.* **42**, 928-1031 (Nov. 1938).

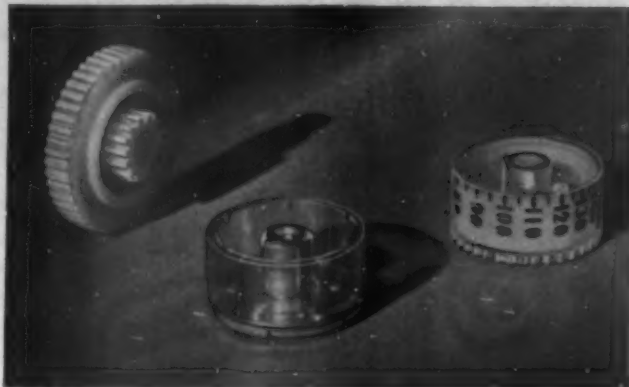
4. Hart-Still, S. C. "Plastics and Production." *The Aeroplane* **55**, 580-2 (Nov. 9, 1938).

5. Caldwell, F. W., and Clay, N. S. "Micarta Propellers." Technical Notes Nos. 198-201 of the National Advisory Committee for Aeronautics, 1924.

6. Kresmer, O. "Synthetic Resins and Their Development for Airplane Structural Materials." *Jahrbuch 1933 der Deutschen Versuchsanstalt für Luftfahrt*, Part VI, pp. 69-81.

7. Kline, G. M. "Plastics as Structural Materials for Aircraft." *MODERN PLASTICS* **13**, 35-6, 68 (Aug. 1938); **14**, 44-6, 66 (Sept. 1938). See also N. A. C. A. Technical Note No. 628.

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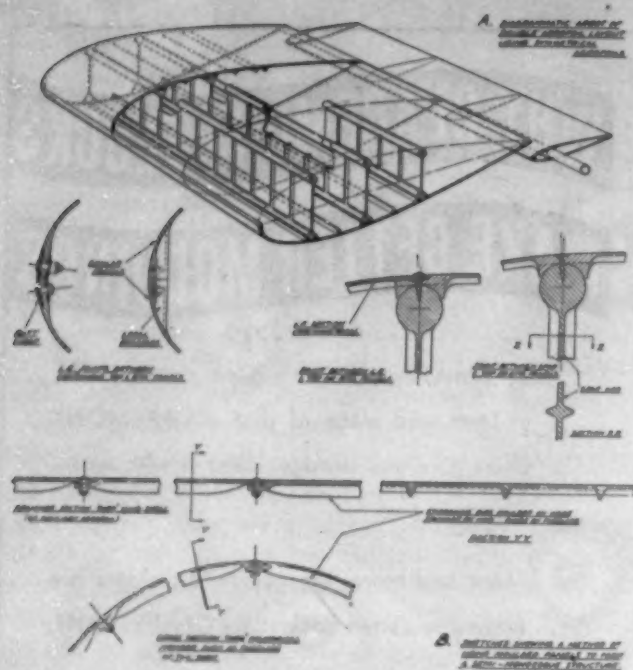
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Above: Design proposed by Hart-Still for an airplane wing. (From J. Royal Aero. Soc.)

motored commercial machine this figure is 13.6 to 1. The greatest number of panels off the one tool in the single-motored machine is 36, and in the twin-motored machine 64. Tool cost per square foot of molded area is about \$73 for the single-motored and about \$59 for the twin-motored airplane, but the actual cost of tools per square foot is approximately \$849 and \$805, respectively. Regarding production time, if half an hour were allowed for each panel, as curing time is a question of minutes only, the time required per airplane would amount to 82 hours and 135 hours for the two machines, respectively; this would be the production time for the basic panels from which assembly is made. Assembly of the finished panels is again more rapid and less costly than construction by the present methods, as skilled and experienced labor is not required to anything like the same extent. Applied to aircraft construction, the principle of molding in plastics does then utilize all the advantages which are normally associated with plastics in other industrial fields; and the apparent limitations are no more than the ordinary difficulties which confront any other effort to break fresh ground. Such large-scale development as that envisaged here must take time and effort, but that it is progressive is proved by the small jobs now being completed."

The molding of complete aircraft members in a maximum of two or three parts would have the definite advantages of superior smoothness of surface, fewer joints as possible sources of failure, and greater rate of production. At least two methods of doing this molding job are available. One is the process developed several years ago by Atwood⁸ which makes use of mandrels or cores around which the plastic-impregnated wood veneer or other reinforcing medium is wrapped

and cured. The other method is more closely related to the usual molding methods in that large metal molds are used to shape the wood-plastic composition, although even in this procedure it is not necessary to use the extremely high pressures and high temperatures required for ordinary plastic molding wherein a fast flow and rapid cure are essential. Thus, huge hydraulic presses are not necessary to either process, although they might expedite production in the latter instance.

The Atwood method of constructing a wing is briefly as follows. Several solid wooden forms representing longitudinal sections the length of the wing are individually wrapped with Cellophane to prevent the finished product from adhering to the forms and thus impeding their removal. Thin wood veneer impregnated with cellulose acetate is wound spirally around the Cellophane covered form. A second layer of the wood is then wound spirally in the opposite direction. Further layers of wood are wound spirally in alternate directions as desired; the greatest number of layers of wood is applied to the portion of the wing adjacent to the fuselage and the number of layers tapers off as the wing tips are approached. The forms are then clamped together and the wing structure as a whole wound with further layers of wood. A layer of thin pigmented cellulose acetate sheet is applied over the whole structure to serve as a surface coating for the wing. A layer of Cellophane is then added and the whole wing is enclosed in a rubber bag from which the air is subsequently evacuated. It is then placed in an autoclave and subjected to approximately 80 pounds steam pressure. This causes the cellulose acetate to flow readily and bonds together the various laminae of wood and cellulose acetate. After a suitable period the wing is removed from the autoclave and the solid wooden forms withdrawn from the interior of the wing, leaving a wing section supported with longitudinal beams. An airplane with wings and fuselage constructed in this manner was built and flown in 1935. It was reported that difficulties were encountered with this ship because of moisture absorption and warpage which can be traced to the use of a plastic which is known to have a marked affinity for water. However, synthetic resins which have substantially lower moisture absorbing properties are available which can be substituted for the cellulose acetate in the above process. The aerodynamical soundness of design of a wing constructed as described above, has been questioned but at least this example will serve to illustrate a proposed technique for molding wings and fuselages.

The second process mentioned above needs very little description as it is quite similar to the procedures at present employed for making small articles having curved shapes, such as trays, from plywood and paper-base laminated plastics. The essential difference may be said to be that larger molds are required for the aircraft members and that other means than hydraulic presses are utilized for applying the necessary pressure. Plywood airplanes have been built by much the same process using thermosetting phenolic resins to bond the veneers,

8. Anon., "Atwood Plane Completed," *Aviation* 34, 64 (July 1935).



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and even other binders such as cold-setting casein glue or urea-formaldehyde resins with the substitution of wooden forms for the metal dies. It is suggested that the term "plastic airplane" is applicable only when use is made of the synthetic plastics to impregnate the veneers sufficiently to adequately protect the wood from absorbing relatively large quantities of water and prevent its deterioration by wood-destroying fungi as well as to act as a water-resistant bond for the various layers of wood. Such a material is simply another type (wood-base) of the well-known paper-base and fabric-base laminated plastics which are well established commercial products in this country and abroad.

The importance attached to these developments in England and Germany is evidenced by the following excerpt from the well-posted British aeronautical journal "The Aeroplane."⁹ "Research (on developing plastics for aircraft construction) is going on in various Government Departments; private concerns such as the De Havilland Aircraft Co., Ltd., and others have made painstaking and lengthy experiments. Another private concern which started work in a small way produced results so satisfactory that one of the largest British aircraft constructors has interested himself in the process. . . . German manufacturers are much impressed with the possibilities of plastic construction. Recently a friend of ours told us about the 10,000 and 12,000 ton presses which the Germans have put up to mold plastic components. Some of our technically minded people dived on these figures and decided after brief calculations that such presses would do nicely to mold sections of wings and fuselages. . . . Another story reached us from a reliable source that the Heinkel works are turning out three fighters a day and that these fighters are molded of plastic materials. . . . We are sure that an enormous number of molded sections of wings and fuselages have been seen in the Heinkel works. Moreover, on various German aerodromes people have seen airplanes of composite construction. Such craft have had frames of steel or light alloy panelled with plastic material, which seems a reasonable step towards the complete plastic airplane."

Finally, as to progress that is being made in this country, the following item from the Washington *Evening Star* (Jan. 25, 1939) provides evidence that there is considerable commercial interest over here in the use of synthetic resins in the construction of aircraft. "A new company for the production of all-plastic airplanes has been organized. . . . If experimental work now being carried on is successful, the company will manufacture airplane wings and fuselages of plastic materials instead of metal. It is said to be working with thin veneers of wood cemented or impregnated with plastic material." The formation of the above company, known as the Aircraft Research Corporation with Eugene L. Vidal as president, is confirmed in the February 11 issue of *Science News Letter*. It is reported that the U. S. Navy Department is already testing sea-plane floats molded in the experimental plant of the

Aircraft Research Corporation. Reference was made in the August 1938 issue of *MODERN PLASTICS* to the investigation of the use of plastics in aircraft construction which is actively under way at the National Bureau of Standards in collaboration with the National Advisory Committee for Aeronautics.

Pioneering experiments in this field of interest both to the aircraft and plastic industries were reported in this month's issue of two years ago. Approximately one year ago Gough noted that aircraft "plastics show more promise than performance." From the evidence of progress reported herein it would appear that an opportunity to evaluate the performance phase of this development is not far off.

LOW COST MATERIAL

(Continued from page 44)

It will be recognized that the cost of the finished powders will not necessarily be in the same order as the cost of the raw materials used. Manufacture of the hydrolyzed powder will require the use of special acid-resisting digesters and filters, in contrast to the ordinary steel digesters suitable for the aniline and sodium hydroxide digestions. Neutralization of the sodium hydroxide will require the use of acid-resistant tanks, but the conditions will not be severe. It is estimated that the final cost of the finished powder will be less than double the cost of the raw materials used.

Experimental part

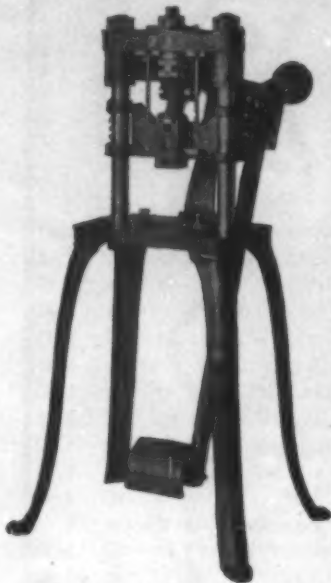
Hydrolysis with acid: A series of digestions was made using bagasse furnished by Louisiana sugar mills. Temperature, time, and acid concentration were varied over wide ranges in an effort to gain an insight into the effect of the hydrolysis. Digestions were made in a stationary steam-jacketed autoclave in the following manner: Two and one-quarter pounds of air-dry bagasse of known moisture content was placed in a lead-lined pail with nine times its weight of water (the amount necessary to cover the bagasse) and the predetermined quantity of acid. The pail was partially submerged in water in the autoclave. Temperature and pressure were maintained by indirect steam for the required period of time. Steam pressure available was limited to approximately 90 pounds per square inch. Through cooperation with the Forest Products Laboratory two additional digestions at higher pressures were made in an acid-resistant bronze autoclave. The autoclave was preheated for a short time with steam. Six pounds of air-dry bagasse of known moisture content was then placed in the digester with $2\frac{1}{2}$ times its weight of water and the required amount of acid. Steam was then admitted directly to the digester to obtain the desired pressure, which was maintained while rotating the digester end over end by means of a motor-driven mechanism at about four revolutions per minute. Condensate approximately doubled the amount of water present by the end of a $\frac{1}{2}$ -hour digestion. In all cases, the hydrolyzed bagasse was washed on a vacuum filter or fine screen and dried to less than 0.5 percent moisture. The dried material was ground in a chopping mill to pass through a 1-mm. screen.

The resulting powders were analyzed for lignin, cellulose, and alpha-cellulose to estimate the degree of hydrolysis. Lignin was determined by the method of Ritter, Seborg, and Mitchell,¹⁷ modified by a 2-hour pre-extraction with 2 percent sulfuric acid. Cellulose was determined by the method of Norman and Jenkins.¹⁴ Alpha-cellulose was determined as outlined by Schorger.¹⁸ Results of the analyses are shown in

14. Norman, A. G., and Jenkins, S. H., *Biochem. J.*, vol. 27, pp. 818-831 (1931).
17. Ritter, Geo. J., Seborg, R. M., and Mitchell, R. L., *Ind. Eng. Chem., Anal. Ed.*, vol. 4, p. 202 (1932).
18. Schorger, A. W., *The Chemistry of Cellulose and Wood*, McGraw-Hill, New York, p. 539 (1926).

9. Anon., "Developing Plastics," *The Aeroplane* 55, 430 (Oct. 12, 1938).

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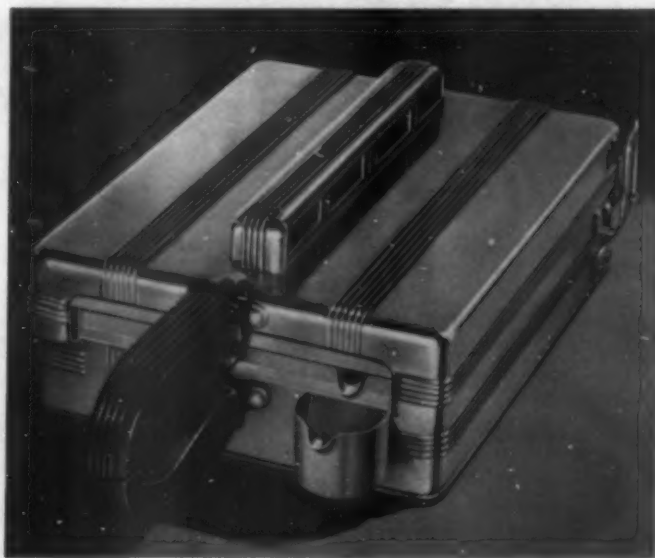
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Table 1. Preparation, Composition, and Tests of the Various Plastics

Experiment No.	Material	Digestion		Chemicals added to bagasse or corncobs (by wt.)	Yield (basis bagasse or corncobs)	Lignin	Analyses					Chemicals added to digested powder (by wt.)					Modulus of rupture		Moisture absorption		Shore (scleroscope) hardness	Specific gravity
		Time	Pressure				Apparent lignin in raw material ^a	Crude cellulose	Alpha cellulose	Aniline	Furfural	Other	Average	Maximum	Air-dry basis	Oven-dry basis						
		hrs.	lb./sq. in.	%	%	%	%	%	%	%	%	%	lb./sq. in.	lb./sq. in.	%	%						
1	Bagasse	0.5	150	1 (H ₂ SO ₄)	39.20	25.93	15.35	67.24	55.15	8	8	.....	6360	6848	1.76	2.29	87	1.42				
2	Bagasse	0.5	135	1 (H ₂ SO ₄)	39.20	25.83	15.30	68.23	57.27	8	8	.....	6338	6983	1.21	2.36	83	1.42				
3A	Bagasse	3	90	9 (H ₂ SO ₄)	54.00	38.13	20.60	55.68	40.57	8	8	.....	4473	4699	0.56	1.57	86	1.40				
3B	Bagasse	3	90	9 (H ₂ SO ₄)	54.00	38.13	20.60	55.68	40.57	15	15	.....	3405	3843	0.33	1.30	85	1.38				
4A	Bagasse	3	70	9 (H ₂ SO ₄)	60.2	34.24	20.60	56.72	36.57	8	8	.....	4574	4854	1.51	1.94	90	1.42				
4B	Bagasse	3	70	9 (H ₂ SO ₄)	60.2	34.24	20.60	56.72	36.57	8 ^b	8 ^b	30 (Lignin)	1702	2055	..	..	..	1.36				
5A	Bagasse	3	50	9 (H ₂ SO ₄)	63.65	30.71	19.60	59.17	41.16	8	8	.....	4238	4967	2.20	2.69	89	1.40				
5B	Bagasse	3	50	9 (H ₂ SO ₄)	63.65	30.71	19.60	59.17	41.16	8 ^b	8 ^b	30 (Lignin)	2285	2418	Disintegrated		84	1.43				
6	Bagasse	3	30	9 (H ₂ SO ₄)	65.90	28.75	18.98	63.38	50.42	8	8	.....	4982	5018	1.75 ^c	2.85 ^c	85	1.40				
7A	Bagasse	3	80	20 (H ₂ SO ₄)	55.3	49.66	27.40	44.40	38.76	8	8	.....	2895	3121	..	..	89	1.42				
7B	Bagasse	3	80	20 (H ₂ SO ₄)	55.3	49.66	27.40	44.40	38.76	15	15	.....	2648	3007	..	..	90	1.40				
7C	Bagasse	3	80	20 (H ₂ SO ₄)	55.3	49.66	27.40	44.40	38.76	8	8	15 (Asbestos)	3047	3133	0.73	1.32	84	1.45				
8	Bagasse	5	90	21 (Aniline)	79	28.21	22.35	58.75	48.33	0	12	.....	8269	8908	..	1.69	80	1.38				
9	Bagasse	3	90	15 (NaOH) 12 (Furfural)	81.3	23.59	19.20	69.32	51.39	0	0	.....	6561	6934	..	31.50	80	1.40				
10	Bagasse	8	Re-flux	30 (NaOH) 12 (Furfural)	78.4	28.16	22.05	59.61	37.59	0	0	.....	5771	5982	2.42	3.57	81	1.41				
11	Corncobs	3	90	6 (H ₂ SO ₄)	46	33.45	15.4	61.04	42.11	8	8	.....	3089	3258	2.57	3.26	81	1.39				
12	Corncobs	3	90	6 (H ₂ SO ₄)	46	33.45	15.4	61.04	42.11	12	12	.....	2951	3087	1.30	2.30	82	1.36				
	Commercial Powder I												7063	..	0.088	0.34	98	1.34				
	Commercial Powder II												7107	..	0.18	0.42	95	1.41				
	Commercial Powder III												6898	..	0.13	0.38	95	1.38				
	Bagasse used in expts. 1 and 2					17.74		70.38	52.18													
	Bagasse used in expts. 3 to 10					19.23		60.13	42.69													

^a Lignin value multiplied by yield.^b Based on total weight of powder and lignin.^c Some swelling after immersion.

Table 1. Obviously, the results of some of these analyses will be high, where the conditions of hydrolysis were such as to convert some of the resin to an insoluble state. Converted resin can be estimated by comparing the percentage of lignin in the raw material with the apparent lignin in the raw material as calculated from the lignin in the hydrolyzed residue. Certain of the residues show loss of lignin, apparently due to formation of a water-soluble or liquid resin, either of which would be lost in the process of washing.

Plasticization of acid-hydrolyzed powder: In the method used at the Forest Products Laboratory, the dry powder, after grinding, is placed in a ball or rod mill with 8 percent each of aniline and furfural by weight and mixed 15 or 20 minutes, followed by the addition of 0.5 to 1 percent of zinc stearate, and 5 minutes additional mixing. The resulting powder, which varies in color from brown to red and has a pronounced aniline odor, is ready for molding. Powder prepared in this manner will mold readily into flat sheets and simple shallow designs, but does not have a good flow.

In an effort to improve the flow, increased amounts of aniline and furfural, up to 15 percent of each, were added. Although flow was increased, as estimated by the lower pressure required to close a rather deep cup mold, it had the undesirable characteristic of increasing the shrinkage of the molded articles, with the result that the finished articles invariably showed surface checking and sometimes cracked. Flat pieces, however, were made with no difficulty. Moisture resistance was somewhat improved but strength was decreased, as shown in Table 1.

Since lignin is known to have plastic properties³ and since those samples of highest lignin content appeared to have the greatest flow,

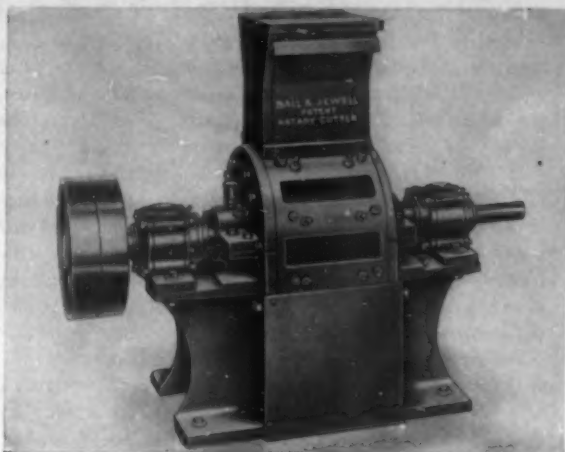
additional lignin, to the extent of 30 percent, was incorporated into the dry powder. Eight percent each of aniline and furfural, based on the weight of lignin and hydrolyzed powder, was added. The resulting powder was bright red in color.

Powders prepared in this manner exhibited flow, as judged by the pressure required, equal to that of one of the good commercial molding powders. It was necessary to cool the mold 10°C. below the curing temperature in order to eject the piece without blistering. The finished pieces had a modulus of rupture only about one-half as great as that of the same material without added lignin, as shown in Table 1.

Since an increase in plastic flow of these hydrolyzed powders always seemed to be at the expense of their finished strength, it was thought possible that the strength could be increased somewhat by the addition of more fiber. It also seemed probable that the addition of asbestos would serve a dual purpose, giving better heat resistance as well as increased strength of the finished piece. Accordingly, 15 percent asbestos was added to the most severely hydrolyzed powder. The resulting molded pieces had a brilliantly lustrous surface and a pleasant feel, but were only slightly stronger than the pieces molded from the same powder without asbestos.

Hydrolysis in the presence of aniline: Inasmuch as high pressure steam was not available at the time this study was made, studies of hydrolysis with water in the presence of aniline were limited. However, one cook was made at 90 pounds steam pressure using 7 pounds of dry bagasse, 1.47 pounds of aniline (21 percent by weight), and 56 pounds of water. Pressure was maintained for 5 hours, following which the material was washed, dried, and ground in a chopping mill to pass through a 1-mm

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screen. The ground material was mixed in a ball mill with 12 percent furfural and 0.5 percent zinc stearate. Molding conditions were the same as for the acid-hydrolyzed materials. The results obtained are shown in Table 1.

Hydrolysis with sodium hydroxide and furfural: Examination of the fractures of various plastics shows that plasticized lignin breaks with an amorphous conchoidal fracture and that as the percentage of lignin decreases the fracture changes progressively through a series of stages which might be designated as fibrous conchoidal, laminated conchoidal, and finally in hard fiber board as laminated fibrous. Strength of the pieces increased as the fracture approached the final type, substantiating the ideas of Bailey⁸ concerning the source of strength. As would be expected, the flow decreased in the same direction. Since the resin in fiber-filled plastics has a tendency to flow to the surface during molding, it was thought possible that strength could be improved without sacrifice of flow by combining a plasticizing with a pulping action, thereby forming the plastic on the exterior of the fibers. This is, to some extent, the same condition existing in the aniline digestion described above, as the aniline is a mildly alkaline reagent.

For a preliminary test, 200 grams of dry bagasse was placed in a 4-liter flask with 24 grams of furfural (12 percent by weight) and 3000 cc of 2 percent sodium hydroxide, and boiled under reflux for 8 hours. Following refluxing, the contents of the flask were poured into 10 liters of water, neutralized with hydrochloric acid, and boiled gently to coagulate the lignin. The mixture was filtered and the residue washed and dried at 60° to 70°C. under vacuum. The material was ground to pass a 1-mm screen in a chopping mill, mixed with 0.5 percent zinc stearate in a ball mill, and molded under the usual conditions. The analyses and tests of this material are shown in Table 1.

An additional test of this method of preparation was made using 2 pounds of dry bagasse, 0.3 pound sodium hydroxide, and 0.24 pound furfural in the pressure autoclave at 90 pounds per square inch steam pressure. Digestion was continued for 3 hours, at the end of which time the contents of the autoclave were dumped into a 50-gallon steel barrel. The barrel was filled with water and the contents were thoroughly mixed and neutralized with sulfuric acid. The resulting fiber and precipitated resin were filtered out and washed in a basket centrifuge. The material was subsequently treated as in the previous instance. Results are shown in Table 1. The flash resulting on molding this material is apparently amorphous, but is unusually tough and flexible—properties less marked in the flash from the phenol-formaldehyde type resins and absent in bagasse plastics obtained by the acid-hydrolysis method. These properties of the flash serve as an indication of the possibility of utilizing this powder for molding strong thin sections. Further investigation of this method of producing plastics is in progress.

Utilization of waste materials other than bagasse: The similarity between the analyses of bagasse and that of other fibrous plant materials (Table 2) leaves little doubt that the methods of preparing plastics described herein could be applied to any of the stalk plants without difficulty. There was some doubt regarding the applicability to waste materials, such as corncobs, in which the cellulose present is in a weaker or shorter-fibered form. For this reason, a molding powder was prepared, as a check, from corncobs hydrolyzed by 1 per cent sulfuric acid (6:1) at 90 pounds per square inch steam pressure. Results of tests on this material are shown in Table 1 and should be compared with those of

TABLE 2. APPROXIMATE ANALYSES OF VARIOUS PLANT MATERIALS^a

Material	Cellulose	Alpha-cellulose	Lignin	Pentosans
	%	%	%	%
Bagasse	60	43	19	29
Cornstalks	46	35	18	28
Wheat straw	53	34	19	28
Seed flax straw	65	50	22	20
Jerusalem artichoke tops	..	23	12	15
Corncobs	71	43	19	32
Oat straw	53	44	19	3

^a Data gathered incidental to other work in this laboratory. Percentages based on oven-dry material.

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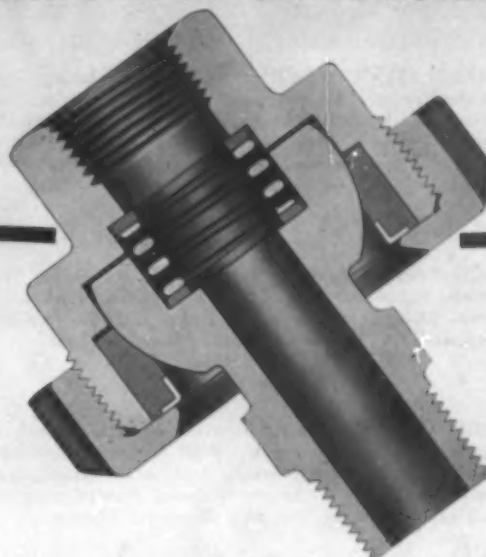
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the 90-pound hydrolysis of bagasse (No. 3A in Table 1). It will be observed that both the yield and the strength of the corncob material are considerably lower. However, it is probable that the process could be modified to include corncobs as a raw material.

Testing methods: Present indications are that these materials will find their greatest field of usefulness in the preparation of flat pieces such as panels, desk tops, tiles, etc. For such purposes, it would seem evident that the most important characteristics of the finished boards will be flexural strength, resistance to moisture absorption, specific gravity (as a factor of cost), impact strength, and surface hardness.

Although some experimental work has been done at this laboratory, and at a commercial plant, on the effect of preheating, curing temperature, and other factors, it was felt that in the present study such experimental work on the several powders prepared was of doubtful value until the optimum conditions of preparation had been approximately determined. This phase of the work, therefore, was disregarded and arbitrary molding conditions were selected for making the test pieces. The loose powder was loaded into a cold 3-inch (7.62 cm) diameter button mold and pressed in a steam-heated platen press at 3500 pounds per square inch and 325°F. (163°C.) for 20 minutes, followed by cooling under pressure to 176°F. (80°C).

Modulus of rupture was determined on pieces sawn out of the 3-inch disks by means of a carborundum saw. The A.S.T.M. specifications³ were not followed, because it was felt that in the case of boards the load should be applied in the same direction in which the molding pressure was applied, as this is the most likely direction of stress in sheet material. After the pieces were conditioned by drying in an oven at 50°C. (122°F.) for 48 hours, they were cooled to room temperature in a desiccator. Width and thickness of the specimens were determined by use of a bench micrometer. A Schopper instrument for determining the tensile strength of paper was used. For this purpose, it was modified as follows: The jaws for holding the paper specimen were removed and replaced by a cross-breaking head having two knife-edged supports 2 inches (5.08 cm) apart for holding the specimen and a center knife edge for applying the load, the knife edges being rounded to comply with A.S.T.M. specifications. For comparison, samples of three different phenol-formaldehyde type resins were tested in like manner. The values shown in Table 1 are averages of not less than six samples.

The specific gravity of the finished pieces was determined by weighing specimens of known volume.

Moisture absorption was determined according to the A.S.T.M. specifications,³ using a 3-inch (7.62 cm) instead of a 4-inch (10.16 cm) diameter disk, as a 4-inch diameter mold was not available. The samples were weighed, dried at 50°C. (122°F.) for 48 hours, cooled in a desiccator, weighed, immersed in water 48 hours, wiped dry, and weighed again. Moisture was computed on both the air-dry and oven-dry basis. Samples that showed signs of swelling are so designated.

Since there are possibilities that these materials would find use in such places as switch-box panels and radio panels, it is of interest to note that the Forest Products Laboratory³ reports an electrical resistance value of 5×10^{11} ohms per square centimeter at 30 percent relative humidity. It is believed that the materials prepared from bagasse will have a similar value. However, due to lack of suitable electrical equipment, these values were not determined.

While the flat pieces of 3-inch diameter from which the specimens used in the tests just described are relatively simple to mold, some question arises as to the practicability of molding larger pieces. A mold was therefore constructed of mild steel to make sheets 9 inches square. Enough powder (345 grams) was placed in the mold to produce a finished piece approximately three-sixteenths of an inch thick. No particular attention was given to the distribution of the powder. The mold was then placed in the press under 3500 pounds per square inch at 325°F. for 0.5 hour, and cooled to 194°F. while still under pressure. The resulting pieces were lustrous black, free from uncured edges, and had a very pleasing appearance. Pieces made from the hydrolyzed powder showed a slight tendency to warp, while those prepared by digestion with aniline or with the sodium hydroxide-furfural method seemed entirely free from this tendency. Further studies of proper molding temperature and curing time will probably eliminate difficulty in all cases.

3. American Society for Testing Materials, Report of Committee D-9 on Electrical Insulating Materials (1936).